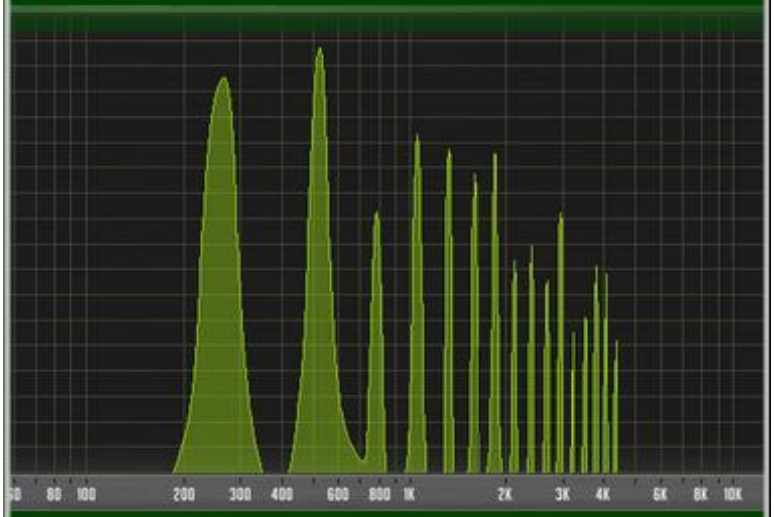
MATHEMAGICAL MUSIC PRODUCTION

All is one and one is all



DERRICK SCOTT VAN HEERDEN

Mathemagical Music Production

All is one and one is all

By Derrick Scott van Heerden

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Introduction

This book is the result of more than 10 years of research and practical experimentation that I have done into the world of sound, its connection to the universe and its effects on people.

To do this this properly I moved out of the city and into the countryside in 2001, leaving my band and DJ career so that I could work undisturbed and uninfluenced by social matters. I spent weeks, months and eventually years either out in nature thinking or isolated in my workroom, reading a lot, trying many sonic experiments and drawing many charts full of frequencies and ratios.

Using this time well, I designed a system where all aspects of my music were in harmony with each other, the BPM of my track, the frequencies of all the notes in my scale, the effects, the types of melodies used, and all other aspects of my sound.

I also learned how to embed various brainwave entrainment frequencies, such as binaural beats, isochronic tones and even subliminal sounds into this music in ways that were harmonious and in time / tune with the music itself and so did not disturb the sound at all, but instead used it as a resonator to make them even more powerful.

While learning to do this I had to do quite a bit of mathematical calculation, dividing and multiplying of frequencies. After doing this for some time I noticed that certain frequencies would appear over and over again because they were more useful and easy to work with than others, these numbers could be divided or multiplied in many ways while still staying nice and whole and not spawning too many decimals and confusion.

Soon I had a collection of these useful frequencies that were the best for all kinds of mathematical calculations, I called them "magic numbers". When I looked closer at these frequencies I found them to be in numerical harmony with many things, like the orbit and rotation of the earth, the size of the sun and the moon, the golden ratio, sacred geometry, the harmonic series, and even the speed of light itself.

Frequencies like 256 Hz, 192 Hz, 288 Hz and 432 Hz have actually been considered to be sacred or mathematically use full by many people for thousands of years, even as far back as ancient Egypt and Sumer. It is these same numbers that seem to have been used in the construction of Stonehenge, the Great Pyramid of Giza, the Pyramid of the Sun in Mexico, the Parthenon in Greece, Angor Wat in Cambodia and many other sacred sites.

In this book you will find lots of information about these matters. But most importantly you will find tutorials that will teach you how to make music on a computer or with acoustic instruments that is tuned to these very same interesting frequencies.

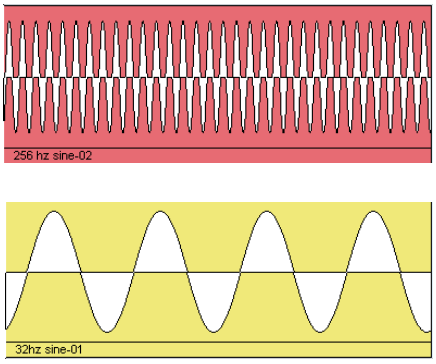
How sound works

I will begin by explaining some very basic things. You may already know this stuff but I want even people who don't play music to understand this too, so I will start this chapter with the most basic of basics and move into the good stuff soon afterwards.

What is sound?

Sound is a vibration that travels away from its source in all directions as air pressure waves. These waves are shaped like many bubbles or "spheres" that are inside each other, different sounds have slightly differently shaped spheres and so they are not really perfect spheres but more like spheres with different textures and curves. When we look at sound waves on a PC they don't look like bubbles, they look like waves showing you how many bubbles are being produced over a certain amount of time.

The two images below are of a sine wave. A sine wave is the most pure type of sound and is the only sound wave that has this perfect curved shape.

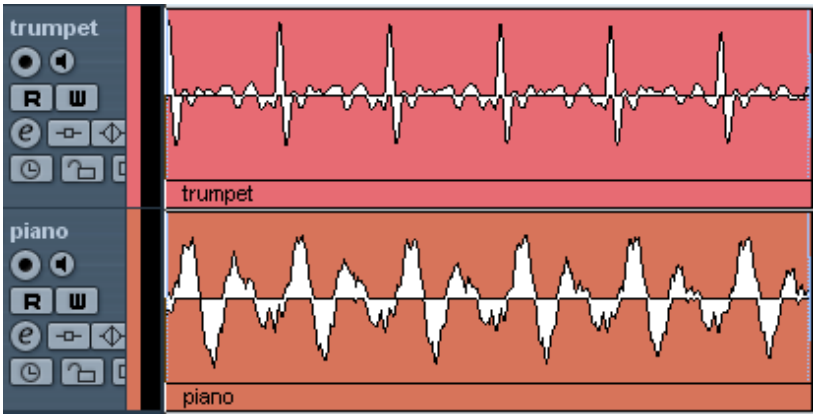


The high pitched sound above has a higher vibration and so has many small waves/bubbles that are closer together, while the low pitch bass sound below has a lower vibration and so makes less waves/bubbles that are bigger over the same amount of time.

Your speakers also vibrate according to this wave. When the wave is at the top your speaker is pushed forward, when the wave is at the bottom your speaker is sucked in and when in the middle so is the speaker. The same thing is true for a drum skin or tuning fork, as it is the vibration of the object producing the sound that makes the air vibrate in waves that then move away in all directions and make other objects like your ear drums and body vibrate.

Sound. light, atoms and orbits are all vibration based, so understanding music and sound which are based on vibration and harmony between vibrations can help you to understand many other seemingly unrelated things in the artistic, spiritual, magical and scientific fields.

If you look at the sound waves of different musical instruments on a computer you will see that each one has a waveform that looks different. Middle C on trumpet will have the same amount of waves over the same amount of time as middle C on a piano, but the waves themselves will be a slightly different shape. As bubbles these would not be perfectly smooth as with a clean sine wave.

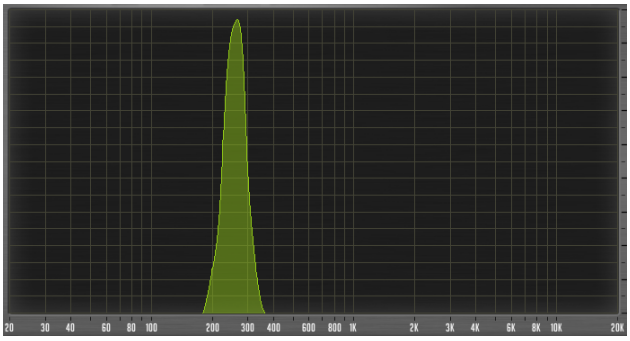


So what is it that makes these sound waves different shapes? The very simple and amazing fact that almost all musical sounds are actually made from various combinations of pure sine waves, more specifically they are made from one single "fundamental" sine wave and then many smaller/higher sine waves called "harmonics" or overtones all mixed together to make a new sound wave. These overtones are what define the timbre of each different sound.

Whenever two or more different pitches are played at the same time their sound waves interact with each other to produce a different and more complex sound wave. Although all musical sounds are made from sine waves in various combinations they almost never occur as single waves in nature or musical instruments, this is just one of those strange facts.

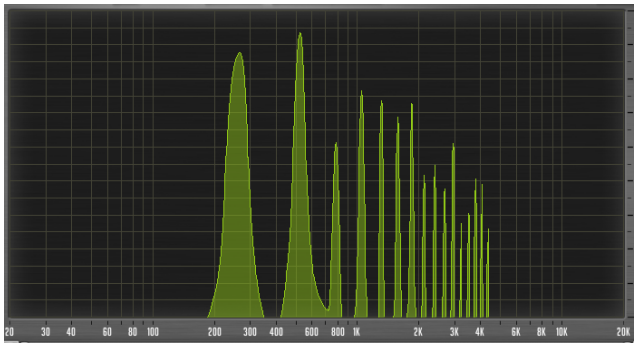
There is another way to view sounds on a computer, and that is by using a spectrum analyzer. You can download the same spectrum analyzer used in the following images (Voxengo Span®) for free at this link http://www.voxengo.com/product/span/. With a spectrum analyzer you can see all the harmonics in a sound instead of just the waveform. In the next image you can see the spectrum analyzer view of a pure sine wave from a synthesizer playing middle C:

Pure sine wave (middle C)

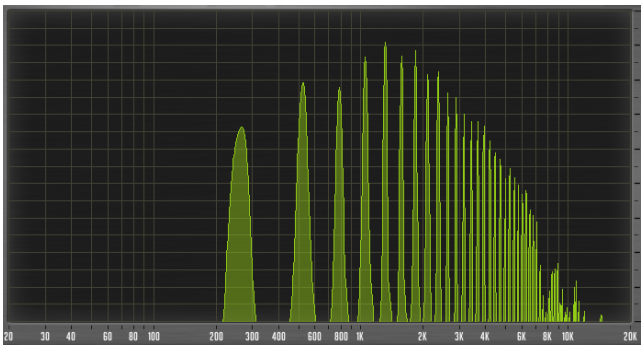


Now let's look again at the sounds of the piano and the trumpet also playing middle C, but this time through the spectrum analyzer:

Piano (middle C)



Trumpet (middle C)

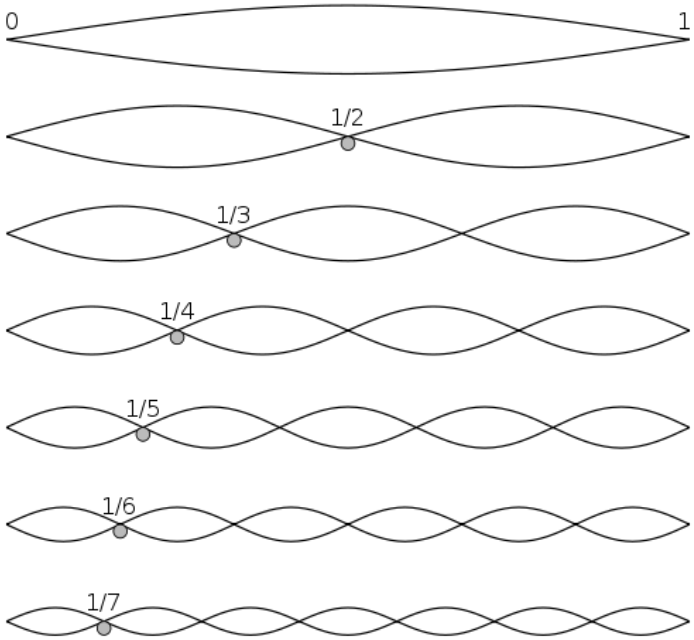


As you can see, the trumpet and the piano both have that same fundamental C sine wave on the left while the rest of harmonics or overtones all have the same-sized intervals or gaps between them. The amount of harmonics and their volumes are different but the intervals between them are always the same. These variations in the volumes of the harmonics are what make a piano sound like a piano and a trumpet like a trumpet. There are instances such as over stressed strings and certain bell sounds where the overtones behave in a different way, but generally for any nice musical sound they will follow this exact pattern.

Harmonic Series

These natural intervals or spaces are known as the harmonic series and as you now know they are the basis of most musical sounds.

Another way to look at the harmonic series is by dividing a piece of string into the even parts seen in the image below



These are the same intervals as seen in the spectrum analyzer pictures, getting closer and closer together as you go higher up the spectrum. While most musical sounds like the human voice, a violin or a piano have this arrangement of harmonics, there are also sounds that do not. A noisy sound like cymbal or thunderclap will have a jumbled mess of harmonics, these harmonics do not all fit into the overtone series in the same way that the harmonics in a nice musical sound like a violin or piano do but are arranged in a more random manner.

Any sound can actually be modeled by playing many different synthesized sine waves arranged in the same way as the original sound. This is how many digital synths work, recreating piano and other sounds using only sine waves.

Despite the fact that the synthesized piano will sound like a piano, it will obviously never sound as authentic as a real piano. There definitely is some magic in real harmonics that is not present in synthesized ones. You can prove this by taking any digital or VST synthesizer and pushing the resonance on you main filter to full. If you now do a filter sweep through the resonance-enhanced harmonics of your sound it will not make a nice sound, it is more likely to be a less than pleasing sound which may even hurt your ears. But try the same thing with a 100% analogue Korg ms-20 or Moog, and you will get lovely smooth overtones similar to whale sounds.

This is because the analogue synth actually makes real harmonics while the digital synth only tries to model them. This is also the reason why real tube amplifiers sound so pleasing while digital tube emulators seem to have a very hard time "modeling" these harmonics in a way that sounds exactly the same as the real thing. It is also the reason why cutting frequencies sounds better than boosting with digital equipment while with analogue equipment you can boost frequencies all you want.

The harmonic series is also what you hear in overtone chanting, where the singer learns to use their mouth to boost each overtone individually and play a kind of melody with them. This means that whenever you speak you are actually generating the harmonic series in the tone of your voice. Without it you would just sound like an old dog barking.

The tones of a monochord, Bushman bow, jaw harp and especially the bugle also use these same harmonic intervals as melodies, if you hear these intervals as a melody they sound very familiar and comforting. The bugle is in fact an amazing instrument, it is like a brass trumpet but it has no valves or keys, you can only change notes by blowing harder or softer into the mouth piece. The result of this is that the bugle can only play the notes of the harmonic series in their natural order and no other notes.

If your bugle is tuned to C, then the notes it will play will be will be C, C1, G1, C2, E2, and G2 (harmonic series). Most bugles are tuned so that it is hard to play the lowest C, making the actual notes C, G, C, E and G. These notes are the same for a monochord, jaw-harp or overtone chant when played or sung in C, although some instruments do extend higher into the series than others.

Just as these harmonic series tones are the basis of most musical tones, so they are also the basis of many musical chords and melodies. This is so because between them they contain the main intervals that we use in many scales and much good music: the octave, the fifth, the fourth, the major third and the minor third, these intervals are what you call "pure" intervals. They sound about the same but are slightly differently tuned to the standard equal temperament intervals with the same names. This however will be properly explained later in the book.

As a number sequence the harmonic series is very simple. If you start with 1 Hz it will be 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 etc. Here is how you calculate the harmonic series of any frequency; I will use 9 Hz for an example:

Sum	Frequency	Name	note
9 Hz x 1 =	09 Hz	1st harmonic	D
9 Hz x 2 =	18 Hz	2nd harmonic	D
9 Hz x 3 =	27 Hz	3rd harmonic	A
9 Hz x 4 =	36 Hz	4th harmonic	D
9 Hz x 5 =	45 Hz	5th harmonic	F#
9 Hz x 6 =	54 Hz	6th harmonic	A
9 Hz x 7 =	63 Hz	7th harmonic	C
9 Hz x 8 =	72 Hz	8th harmonic	D
9 Hz x 9 =	81 Hz	9th harmonic	E

Another way to calculate the harmonic series is to add the first frequency (9) to itself and then to keep adding it to your answer over and over again. So for 9 it would simply be 9 + 9 = 18, 18 + 9 = 27, 27 + 9 = 36…

If you look at the “frequency” column you will see that the first number of each successive Hz frequency is 1,2,3,4,5,6,7,8 going downwards and that the second number in each does the same thing going upwards. This only seems to work when you start with the number 9.

What does Hz mean ?

To measure the frequency of sound waves we need to use numbers, the standard way to measure sound waves is in cycles per second. The term used for this is Hertz or Hz, this means that if you hit a 432 Hz tuned tuning fork or play a 432 Hz tone on a speaker that they will vibrate exactly 432 times in one second and so will also make 432 air pressure waves or "bubbles" per second. Hz is a very important measure and will be used throughout this book along with BPM (beats per minute) to measure frequencies of beats and audio tones.

Octaves

Now that you know what Hz means it becomes easy to understand the next important thing, the octave. If you make a guitar string exactly half its length it will play the same note but one octave higher, and if you play middle C on a piano then its octave will be the next C on the piano. This is the second harmonic in the harmonic / overtone series.

An octave in mathematics is any number or frequency doubled or halved (multiplied or divided by 2). You can go upward or downward forever into infinity with octaves, there is always another number twice as big or half the size of the number you have.

If you are working with rhythms then an octave higher will be the same beat, but exactly twice the speed. The octave is the most common rhythm in all music and musically it is the most harmonious harmony.

There is actually a law called the "law of octaves" found in various other scientific and esoteric places. It states that when a vibration doubles in frequency, it will naturally divide into harmonic parts with the octave always having similar properties to all other octaves of that frequency. Just like C on a piano has very similar properties to the next C and all other C's on the piano while it has less similar properties to the rest of the notes in-between.

This explains how while working with sound frequencies and music you can freely multiply or divide a frequency by 2 any number of times, doubling or halving it in octaves to get bigger or smaller frequencies that will always have very similar properties and be in perfect harmony with the original frequency (something that is done a lot in this book and frequency work in general).

The octave occurs in nature too when human life starts, it starts as a single cell which then divides into 2, then 4, then 8, 16, 32, 64, etc, that is why the octave sequence starting with the number one is quite profound as it represents life. One of its octaves, 8Hz is also interesting as it is said to be the natural brainwave state of a very happy and relaxed person.

The Periodic table of elements

Our chemical elements seem to follow a similar law, in the periodic table the elements are arranged in order of increasing atomic number (the number of protons in the nucleus). The periodic table is called the periodic table because when the elements are arranged in this order they repeat their basic properties periodically, lining all of the elements with similar properties up into 18 groups and 7 periods.

Group → 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
↓ Period
1 H He
2 Li Be B C N O F Ne
3 Na Mg Al Si P S Cl Ar
4 K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
5 Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
6 Cs Ba Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
7 Fr Ra Rf Db Sg Bh Hs Mt Ds Rg Cn Uut Fl Uup Lv Uus Uuo
Lanthanides La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Actinides Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr

Sound Entrainment

Entrainment is the name used when a sound affects an object, be it a human brain, a bit of fluff stuck to a speaker, an opera singer breaking a glass with sound, a scientist using acoustic levitation to levitate a drop of water or even shrimps creating light from sound using sonoluminescense.

Sound does not only have an effect your mind, it also affects your body. If you turn your speakers up loud enough you will feel it for yourself. It is a fact that listening to fast music will make you exited while listening to slow music will have a relaxing effect, this works on all levels effecting your brainwaves, heart rate and blood pressure.

It is actually a lot more specific than just feeling relaxed or exited though. Listening to a drum beat at 135 BPM will eventually make your brainwaves entrain to exactly 135 BPM. In this incredible rule of the universe your brain tends to shape your mood according to the sounds that it hears, the random frequencies of thunder for example will make you alert with primal worry while the soothing sound of a didgeridoo will relax you. Because all sounds are vibrations it is really true that all sounds, both rhythms and tones will have entraining effects. Beats on a drum and a smooth audio tone are actually very similar depending on how close you zoom into the waveform, so even a high pitched tone like 288 Hz should still create some form of entrainment even at this high frequency.

Brainwave Theory

Learning about brainwave theory is the best way to understand this. It is also a good scientific place to start because scientists have mapped out our brainwaves using EEG machines and they have tested audio frequencies on people while they are connected to these machines. In doing this they have proven that our brainwaves adjust themselves to the same frequencies as audio tones or rhythms played into our ears and that our brainwaves are divided into different states. It is actually now possible to buy an EEG headset from this company: http://emotiv.com/ and do your own experiments with brainwaves and sound.

There are many charts online that differ on the exact range of each state and the amount of states, but in most of them each state covers approximately one octave. So I have designed my own chart based on all of the charts that I have seen, but where each state covers exactly one octave giving me 7 different states that are pretty much the same as 90% of the brainwave charts I have seen.

Some charts have the eighth state (high gamma) and some don't, high gamma is above the normal rhythmic brainwave frequency range and starts around the point where rhythms come into the range of low bass audio (64 Hz = typical didgeridoo range). These sounds do have entraining effects though, so I have included them here even though they are actually the start of the next level of 7 octaves of audio which ends on 16384Hz, near the start of ultrasound and the end of human hearing range.

Brainwave Chart		
8. High gamma	64Hz to 128Hz	Deep spiritual insight, highest states of meditation, memory and learning, problem solving and high Self-awareness, healing, feeling of unity, super consciousness, enlightenment, body heat generation through meditation.
7. Gamma	32Hz to 64Hz	Very alert, Insight, fast information processing, hyper-activity.
6. Beta	16Hz to 32Hz	Alert, normal waking state for, everyday conscious thinking, clear perception, concentration, critical thought.
5. Alpha	8Hz to 16Hz	Relaxed, at peace, calm, daydreaming, visualization, integration of feelings, memory, enhanced learning ability's, enhanced serotonin release, mood lift.
4. Theta	4Hz to 8Hz	Shamanic experience, Lucid dreaming, hallucinogenic state, creative meditation, pre-sleep, Intuition, Inner guidance, inspiration, Intro-spection.
3. Delta	2Hz to 4Hz	Transcendental meditation, normal state of baby in womb, healing of body, Production of natural opiates.
2. Low delta	1Hz to 2Hz	Harmony, insight, very deep meditation, Sleeping, healing, regenera-tion, endorphin release.
1. Epsilon	0Hz to 1Hz	Out of body experiences, deep sleep, deep of insight, high Self-awareness, feeling of oneness or unity, universal mind, collective unconscious, suspended animation.

If you look at the brainwave chart above you can see that as you move upward through the rhythmic brainwave states starting with the very slow rhythms of Epsilon, that as they get faster they make you more alert, awake and even a bit stressed when you get to the fast drum roll type rhythms of Beta and Gamma.

Then when you get to High gamma they become a smooth relaxing bass audio that has a similar effect on your brainwaves as the very slow Epsilon rhythms. Here they do full circle in properties as far as most standard brainwave charts go too, High gamma is always connected with calm, peace and deep insight just like Epsilon right at the other end of the chart.

This is very similar to octaves in music where each octave is divided into 7 parts (7 notes in a major scale) with an eighth part (octave) that has similar properties to the first (both are C's). Only here we have 7 octaves where the eighth octave has similar properties to the first, very much like a fractal.

Brainwave theory has been known to shamans for thousands of years. Shamans from around the world tend to beat their drums or rattles at about 4 beats per second (4 Hz) to induce shamanic trance states. EEG Tests have been done on people while they were under the influence of various hallucinogens such as Peyote, Ayahuasca and Mushrooms in shamanic situations and also while lucid dreaming, and in most cases spikes in the Theta range were observed proving that the Theta range (4Hz-8Hz) is indeed the correct frequency for shamanic or psychedelic work.

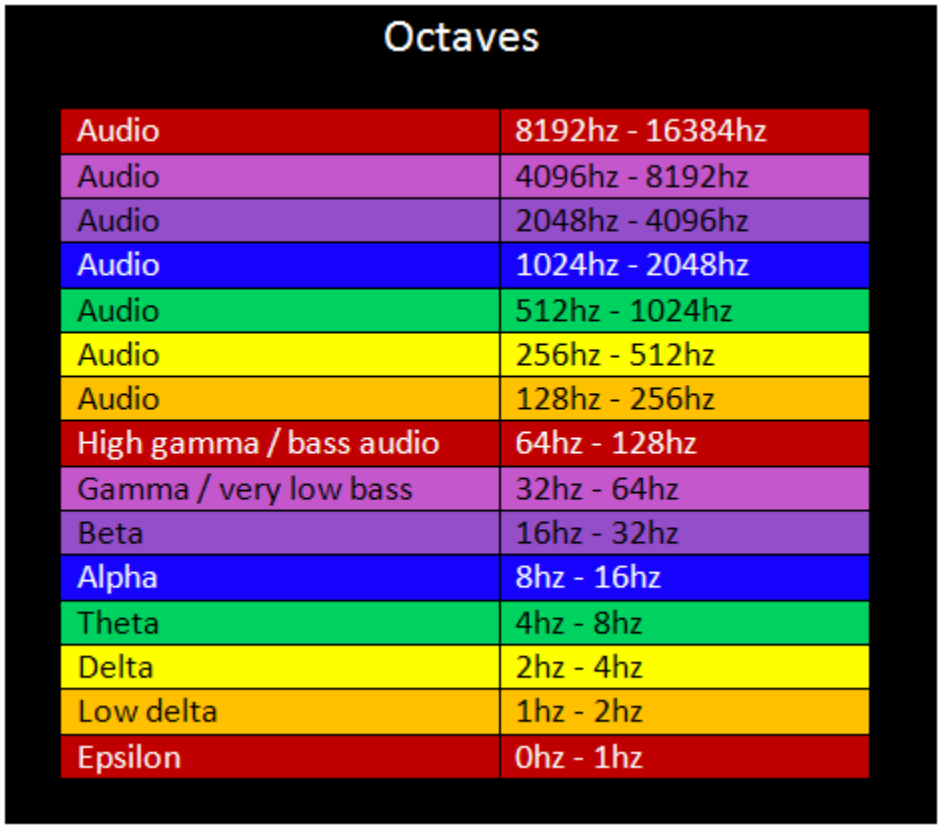
It is important to remember that your brain does not just produce one state at a time; it produces more than one at the same time but in different amounts. So in deep meditation you may have a spike in the Theta or Delta range, but you may still have a low level of Alpha or Beta waves present keeping you awake and conscious at the same time.

Each state being in a new octave explains how our brain could produce all of the states at the same time while still having internal harmony between the different wave frequencies. This is why it is good to use octaves when you generate more than one brainwave frequency at the same time using audio, because each new octave will always fall into the next brainwave state and will always have similar properties to and be in harmony with the frequency one octave below it.

For most people rhythm and tone are two completely separate things, but as far as I am concerned they are the same thing. On the next page I have made an interesting chart to illustrate this. The first 7 octaves (bottom half of the chart) cover the 7 rhythmic brainwave states starting with 0 Hz and ending of 64 Hz, while the second 7 octaves (top half of chart) cover 7 octaves of "normal" audio starting with the low bass of tone 64 Hz ending at the top of our hearing range with 16384 Hz.

Obviously the exact point of crossover from rhythmic to smooth sound varies slightly from person to person, but it is always around 64 Hz. It is interesting to note that the same thing happens with light which is why old 60 Hz refresh rate PC monitors and 60 Hz fluorescent lights caused headaches when people perceived the flashing while 75 Hz did not. (75 Hz was further above our perception of flashing light).

In the chart below the red colored horizontal rows show the points where the properties of sound change from rhythm to audio and then to ultrasound. Epsilon and high gamma have similar properties so it is highly probable that the repetition of properties in the red rows extends to all rows, meaning that the Gamma range just below the High gamma range should have similar properties to the second highest audio frequency range (4096Hz – 8192Hz). For this reason I have color matched all the horizontal rows so that you can see which ones are separated by this seemingly cosmic measure of 7 octaves.


Octaves
Audio 8192hz - 16384hz
Audio 4096hz - 8192hz
Audio 2048hz - 4096hz
Audio 1024hz - 2048hz
Audio 512hz - 1024hz
Audio 256hz - 512hz
Audio 128hz - 256hz
High gamma / bass audio 64hz - 128hz
Gamma / very low bass 32hz - 64hz
Beta 16hz - 32hz
Alpha 8hz - 16hz
Theta 4hz - 8hz
Delta 2hz - 4hz
Low delta 1hz - 2hz
Epsilon 0hz - 1hz

If each of the brainwave states (Epsilon, Low delta etc) were divided into 7 parts to make up a 7 tone major scale inside each one with the eighth note (octave) being the start of the next state, then this would make it all like a fractal.

Within each state you would have 7 smaller "states" each made up of a 7 tone major scale where the eighth note in each will be the first part of the next brainwave state spanning another octave and containing another major scale. This really is like a fractal now, the same laws repeating themselves inside themselves.

There are 2 main modern day "scientific" methods that are commonly used to induce entrainment using sound. They are "binaural beats" and "isochronic" tones.

Binaural beats

The theory behind binaural beats is simple. They work like this: using headphones or carefully placed speakers, you play an audio tone into one of your ears while at the same time playing the same audio tone, but at a slightly lower or higher frequency into your other ear. Listening to this audio will entrain your brainwaves to the frequency that is the difference between the frequencies of the two slightly different tones.

So if you play 100 Hz tone into one ear and a 108 Hz tone into the other, the resulting tone will entrain your brainwaves to 8 Hz (alpha brainwaves).

If you actually listen to this you will hear a kind of wobble pulsing at 8 pulses a second. However if you listen to just one of the tones on its own by switching off one of your speakers of removing one side of your headphone, you will hear just a smooth tone with no wobble.

Apart from entraining your brainwaves to a frequency, binaural beats also have the effect of synchronizing your left - right brain hemispheres so that they fire in a left - right sequence and are in better harmony with each other. I am sure this could increase the efficiency of your brain by interweaving your thought processes more evenly.

Binaural beats are easy to make on a computer as I will explain in the later chapter on practical applications of brainwaves.

Monaural beats

Monaural beats are just binaural beats that are played in mono instead of stereo and so can be played on any speaker arrangement. They are also entraining just like any modulated sound is.

Binaural and monaural beats are most accurate when you use pure sine waves as sources for your 2 audio tones. This is because a sine wave is the purest tone with no harmonics or overtones (overtones will stimulate other brainwave frequencies), and so it is the best sound to use for accurate work where you only want to stimulate one frequency at a time.

Any carrier frequency will still have a strong entraining effect, musical sounds may even be better than pure tones because the harmonics will add more power and some natural variation in the frequencies. The human brain is not used to only generating one frequency at a time so it is possible that forcing this could actually cause imbalance in your brainwaves.

Using sounds which are rich in overtones, especially natural sounds may be better for you. These harmonics will obviously be in harmony with their fundamental pitch, so the extra brainwaves will still work well together.

It is a fact that binaural beats have been used for centuries in this way, for example Tibetans using 2 or more de-tuned Tibetan bowls or Aborigines using de-tuned didgeridoos.

So with any sound all you need to do is de-tune your left / right channels or 2 instruments by a specific amount of Hz, and that Hz frequency will be your brain wave frequency. There are VST plugins that can do this very quickly to any sound source, as I will explain in the later chapter on how to create brainwaves.

Now we get to something important and often overlooked. That is the fact that the de-tune wobble speed and the actual audio frequency of the 2 tones are both going to have entraining effects, this is why it will be best to have the tones themselves set to a frequency that is harmony with the main brainwave frequency or de-tune wobble speed.

The law of octaves is obviously a good thing to use here, so if you want an audio tone that is in tune / harmony with 8 Hz just double or multiply 8Hz by 2 a few times to get higher octaves that are within hearing range, and so can be used as audio tones. In this case 64 Hz, 128 Hz and 256 Hz will be good frequencies to use for tones as they are perfect octaves of 8 Hz. You can also use pure fifths, major thirds or other intervals from the harmonic series for this, not only octaves.

One thing that seems odd with binaural beats is the fact that you are de-tuning your perfectly tuned audio tones. It is fine however because if you use the octave or pure interval method, you will be de-tuning them by a frequency that is in harmony with the tone itself so it all works out in the end.

It takes up to 20 minutes for binaural beats to take full effect. So because your brain is in a Beta state most of the time, it makes sense to start listening to them set to the Beta state and then slowly sweep to the frequency that you want to end up in. This gives your brainwaves time to adjust to the new frequencies.

A very interesting basic program is to start in Beta or Alpha if you are already in a relaxed state, and then to sweep down to Theta and hold the frequency there for some meditation time. From there you could go deeper down to Delta for even deeper meditation, you could even mix in some soft Alpha waves or even some bird sounds at this point to stop yourself from falling asleep.

If you are brave you can approach the no brain waves frequency of 0 Hz right at the bottom of the Epsilon state. Then your 2 audio tones will no longer be de-tuned and will play the same note, I call this the "flat line" and have had out of body experiences at this point, (after the full 20 minute journey).

I find this very interesting, as you slowly lower your brainwave frequencies you go from a normal awake state to deeper levels of your mind. But then as you go to the deepest levels where your brainwaves almost stop altogether you find yourself outside your body and fully "awake", in a state more similar to High Gamma than the deep dreamless sleep associated with Epsilon.

In fact, if you had set your carrier tone to a nice bass drone of 64 Hz then you should now be in the High gamma state and not Epsilon. Suddenly this full circle of properties makes sense, how the highest and lowest brainwave states can be so much the same even though they "should" be so different.

Isochronic tones

Isochronic tones are often sold as some new technology even though they too have been used for thousands of years. All an isochronic tone actually consists of is just a repeating pulse of sound, like a machine going beep beep beep at a specific amount of beeps per second (Hz).

To make an isochronic tone 100% accurate, meaning that a 4 Hz pulse (4 beeps per second) will entrain your brainwaves to exactly 4 Hz, the gaps between the tones need to be exactly the same length as the tones themselves. It is also best to use pure sine waves for accurate Hz work, although any sound will actually work (remember the shaman and his drum, harmonics etc).

As with binaural beats it will be best to also have the tone itself set to a frequency that is in harmony with the speed at which it is pulsing on and off, this is easy using the law of octaves as I have illustrated before. If you want a frequency for an audio tone that is in harmony with a 4 Hz pulse or beat you just multiply it by 2 a few times, doubling the frequency by an octave each time until you get a frequency in the range that you want..

This theory of matching audio tones measured in Hz with lower more rhythmic Hz frequencies using the law of octaves is important. Using this theory and expanding on it to include the tempo of our music (BPM), we can make perfectly harmonious music where our tempo, rhythms, binaural beats, isochronic tones and actual musical notes all add up together to create one harmonic / geometric fractal of sound that will entrain using the same repeating pattern. Once all of your sounds are working together then you can choose a magic frequency as a base and everything will resonate sonically and mathematically with that frequency instead of working against it.

Although this all sounds very cutting edge, it has actually all been done before and is really ancient knowledge that we are just starting to re-learn now. I know from first-hand meetings with African healers that many African tribes have been using brainwave entrainment for centuries, inducing trance states with specific goals like healing disease or traveling to other worlds. When I asked them where they learned this science they mostly said that beings came from space and showed them how to make instruments like marimbas and mbiras, and also showed them how to play all their traditional, ritual and entrainment music. It sounds crazy but this is what they say, even tribes far away from each other that have never met.

The Dogon are a good example of this, they say that their alien friends came from Sirius. It is believable because they knew about Sirius B long before Westerners ever even knew it was there (it is not visible to the naked eye.) The Dogon Clearly state that these beings taught them how to play music and also taught them agriculture and everything else that defines their culture.

I know this is not only the case with Africans. It is also true with Native Americans, and probably many other people around the world, but I live in Africa and prefer to learn from real experience so I know more about Africans than other tribes.

There is one method used by many tribes here that I find to be very interesting:

They sit one person down on a mat, and then they have 2 mbira (thumb piano) players who sit of each side of this person holding an mbira near each ear. They then the play a special interlocking harmonic melody between the two players in which each successive note enters the left, then right ears, creating intense brainwave entrainment.

Some of these people also work with very specific tempos. I have heard of shamans who spent years teaching a pupil to play one simple beat at a very specific speed, they say it can take a lifetime before the teacher says the beat is correct and some even spend a whole lifetime trying without ever getting it right. It is amazing because this beat sounds like the most basic bongo beat when just listened to by anyone who is not familiar with this training.

Another thing that is done all over Africa is to play music using polyrhythms, these are identical to the harmonic series but expressed as rhythms. I have heard songs where one part / loop has 1 beat per loop, the next has 3 (in the same space of time), the next has 4, then 5, etc, just like in the harmonic series but in rhythm form. Although each player only plays a short loop, the loops only line up in the same way as they do at the start of the song after sometime creating a bigger loop only every few minutes in some cases.

I have seen bushmen do a similar thing in their trance dance where the women sing and play 4/4 rhythms on shakers and with hand claps, then when the shaman joins in with rattles on his ankles he dances / plays 3 or 6 beats over the women's 4 creating triplets. Sometimes he will go deeper into trance and change to other ratios / polyrhythms from the harmonic series like 5/4.

The Bushmen also play other instruments like the single string Bushman bow. This instrument only plays the harmonics of the overtone series just like a monochord, but using your mouth as a variable pitch resonator.

The Bushmen are a very tuned in people who are aware of sound fractals and harmonic healing, their shamans are reputed to be the most powerful in all of Africa and can basically see disease with "x-ray" vision and can fix it with their hands. It has been said by some that the Bushmen are the oldest race on earth, so they really may be the wisest too.

Another very common theme throughout Africa is to sing a repeating melody and then to raise the frequency a bit higher at the start of each loop. This could have the effect of raising your vibration to a higher level. It certainly does make me feel amazing.

Some tribes higher up in Africa also eat the powerful hallucinogen "IBOGA" before this trance quest. To join their cult you have to take a massive dose of this plant in order to "open the head" and meet with the spirit "Bwiti" before gaining acceptance, they say that once you have accomplished this you automatically become a shaman. A friend of mine traveled very deep into this land and said he found whole villages occupied entirely by people who were such shaman.

It is not only African shaman doing these types of things, there are shaman all over the world who use sound and plants for entering a trance, or for healing disease. Good examples being the Native American peyote churches, and the San Pedro, Ayahuasca and mushroom shaman of South America.

Every culture on earth actually has shaman, they are a type of person that can get born or reincarnated anywhere from the jungle to the city and back again. What is interesting is that in this modern age we now have some amazing technology that can be put to good use by a new generation of "electric shaman" to get to new levels of trance and sound healing.

Harmonic BPM

Matching the Bpm of your music with its tuning

In the last chapter we learned how to match the frequency of audio tones with lower Hz frequencies that could be used as binaural beats or isochoric pulses. To use this theory and apply it to full music production, the next logical step would be to tune the tempo of the music so that it is also in time with these frequencies. The problem is that your music workstation measures tempo in BPM and audio frequency in Hz, it is easy however to match Hz frequencies with BPM frequencies. I call this harmonic BPM and I have a very easy way of explaining how it works.

The best example to start with is 1 Hz. A clock ticks once every second, so a clock actually ticks at 1 Hz.

1 Hz is also an octave of our 8 Hz brainwave and middle 256 Hz = C, so it is a very good place to start. We already know how to get this harmonic 256 Hz middle C that fits with 1Hz and 8 Hz brainwaves using octaves, so now what we need is a BPM that is in harmony with 1 Hz and its octaves.

This is very easy to work out because there are exactly 60 seconds in a minute, so all you have to do is to multiply 1 Hz by 60 and then we get our answer: 60 BPM. For 2 Hz you get 120 BPM (2x60) and for 3 Hz you get 180 BPM (3x60).

So 1Hz and 60 BPM are exactly the same thing, a clock ticks once every second (1 Hz) and a clock also ticks 60 times in a minute (60 BPM).

We have the ancient Sumerians to thank for the fact that there are 60 seconds in a minute. It was them who actually invented what we call “Base 60 mathematics”, base 60 mathematics is very interesting because you will find that certain numbers multiplied or divided by 60 will give you very nice round numbers while others will not. So if you use it to make a music scale or to build a building it will work better if you base your calculations on specific numbers and not random numbers.

What is really crazy is that the numbers that work the best are always the same ones that are considered sacred by many cultures, not only the Sumerians but also the Ancient Egyptians, Mayans and others but I will get into that later.

Next is a chart to show the harmonic BPM'S for 1 Hz and some its octaves which are all usable as harmonic BPM'S for 1 Hz and all of its octaves:

Converting Hz to Bpm

HZ	X 60 =	BPM
1	X 60 =	60
2	X 60 =	120
4	X 60 =	240
8	X 60 =	480
16	X 60 =	960
32	X 60 =	1920
64	X 60 =	3840
128	X 60 =	7680
256	X 60 =	15360

Now things start to get interesting. If you play a drumbeat at 15360 BPM it will not sound like a beat, it will play an exact middle C = 256 Hz audio tone with its timbre defined by the type of drum sound that you used. Now you can see that all frequencies on both sides of the chart above are really “C’s”, all octaves of each other.

You can also start with a BPM and then work out the harmonic Hz frequencies by reversing the sum. (120 BPM divided by 60 equals 2 Hz).

Converting Bpm to Hz

BPM	/ 60 =	Hz
120	/ 60 =	2
240	/ 60 =	4
480	/ 60 =	8
960	/ 60 =	16
1920	/ 60 =	32
3840	/ 60 =	64
7680	/ 60 =	128
15360	/ 60 =	256

By using simple sums like these to make your music you will find that it will be in very good harmony with itself creating entrainment within entrainment, drumbeats in harmony with audio and if you add binaural beats or tempo-synched modulated effects, they will be in harmony with all aspects as well.

Even with equal temperament tuning it is easy to adjust your bass frequency to match your BPM using master tune and Hz checking / guitar tuning software or hardware to get everything more or less in tune.

I did some research and it turns out that I am not the only one who thought of this either. In modern times people have discovered that classical style music especially Baroque music played at 60 / 120 BPM and based around the C major scale will have what they call the "Mozart effect". This is said to have many benefits such as enhanced creativity, more focused thoughts, balanced brainwaves etc.

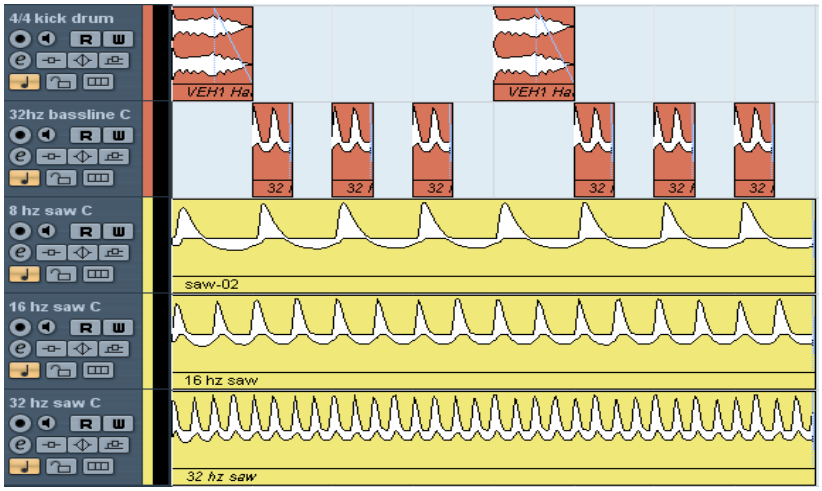
If you take a close look at the very low octaves of C = 256 Hz on your music workstation with its tempo set to the correct harmonic BPM of 120 BPM it is easy to see that the number of waves in each note's waveform always fits exactly into your grid quantize and tempo. When you play those very low C octaves on a synthesizer using saw tooth waves (so that the note breaks up into a pulse or growl type sound) you will find that the timing of these saw tooth waves will be exactly in time with the beats and rhythms in your music. This is how you can make the best "dark" growling bass lines that are full of isochronic mind-altering power because their audio frequency matches the tempo of your music.

In this image:

Orange = 120 BPM typical trance kick/bass with harmonic audio frequency of C = 32 Hz on the bass synth.

Yellow = plain 1hz, 16hz and 32 Hz saw tooth wave audio tones (octaves of C) for comparison. You can see how they all line up in perfect harmony / geometry.

I used trance as an example because of the clear beats, but this works for all music even very relaxing ambient sounds.



The next chart has all the harmonic Hz octaves for 120 BPM and some typical sound examples. Looking at it like this makes it easy to see how musical notes are actually the same as beats and that beats are in fact very low musical notes, all in one spectrum.

HZ	Sound example for music at 120 Bpm	Brainwave state
1 Hz	Half time snare drum	Low delta
2 Hz	Straight House / trance Kick drum	Delta
4 Hz	Double-time hi-hat / “theta” shaman drum	Theta
8 Hz	“Kbbb”darkpsy kick & bass / 16 beat shaker	Alpha
16 Hz	fast drum roll	Beta
32 Hz	Faster drum roll	Gamma
64 Hz	Bass synth audio, low C	High gamma
128 Hz	Higher C	
256 Hz	Middle C	
512 Hz	Next C	
1024 Hz	C	
2048 Hz	C	
4096 Hz	C	
8192 Hz	C	
16384 Hz	Last C before human hearing range ends	

The Pythagorean scale

Up until now we have been working mainly with octaves and fifths, so in this chapter we will explore a full musical scale called the Pythagorean scale.

To work with such scales I use free software called "Scala", with this software you can make any of the scales in this book into tuning files that can be loaded into various software and hardware synths and applications. But you will find out exactly how to make and use these files in the later chapter on tuning instruments. So for now when I talk about setting scales to different reference pitches and when I show charts of frequencies from scales, just keep in mind that in the later chapter I will show you what free software to use and how to use it to tune synthesizers to these scales, and also how to generate charts so that you can study the frequencies.

As you know all pleasant musical sounds are made from sine waves arranged according to the harmonic series. So finding a scale that is in tune with this will help to reduce internal disharmony in our music, tuning our melodies to the frequencies within the sounds themselves.

I mentioned that the harmonic series contains a perfect fifth and that this perfect or pure fifth is not the same as a fifth in equal temperament tuning (default on most instruments). The equal temperament fifth is based on this pure fifth but it is not exactly pure, it is slightly out of tune.

Another problem (for exact Hz work) is that the default reference pitch around which this equal temp scale is built is A = 440 Hz so all the A's are octaves of 440 Hz and the rest of the notes are equally spaced around this frequency (exactly 100 "cents" between each note to be precise).

When you try to use this scale with brainwaves or harmonic BPM you will find that all of the other notes including the fifth have frequencies called "irrational numbers". These never end and go on to infinity, eg: 281.625643676…Hz, this kind of number mess usually means that the harmony between these tones is not much good either.

These kinds of numbers are useless for finding lower octaves for use with brainwaves and also for finding harmonic BPMs because it is impossible to type them into any software or calculator to even start making calculations.

Here is a chart showing the frequencies of the A = 440 Hz equal temperament scale:

Equal Temperament A = 440 Hz	
A	220.0000 Hertz
A#	233.0819 Hertz
B	246.9417 Hertz
C	261.6256 Hertz
C#	277.1826 Hertz
D	293.6648 Hertz
D#	311.1270 Hertz
E	329.6276 Hertz
F	349.2282 Hertz
F#	369.9944 Hertz
G	391.9954 Hertz
G#	415.3047 Hertz
A	440.0000 Hertz

The software (Scala) that I use to work with scales (and used to calculate this chart) cannot show more than 4 digits after a comma so the numbers are longer than what you see here. All software has this number limitation, some software only allows 2 or 3 digits after the comma so to be sure that a number is usable it needs to have a zero at the end (eg 440.0000). If not you must be very sure that there is not another hidden number at the end that the software won't show you (eg 391.9954???).

This is quite interesting because all of the "sacred" numbers from those ancient cultures seem to have this property of numerical "roundness". This is in fact how I discovered them, through pure need and not through a specific search for “cosmic” numbers. It does all make sense though, the ancient cultures used hieroglyphics and cuneiform and so would have had good reason to avoid irrational numbers.

The A = 440 Hz based equal temperament scale only has one rational frequency and that is 440Hz itself, so you could make music in A at its harmonic 103.125 BPM but that is very limiting for many different songs.

Obviously you can use the master tune on your synth to change 440 Hz to 432 Hz but you will still be stuck with the equal temperament scale which even when tuned to 432 Hz still has irrational frequencies and intervals between all of its notes. These intervals are not exactly in harmony with the harmonic series and they are not very harmonious with each other either when compared to some other "pure" scales.

What you need to look at is the spacing between the notes in your scale, you at least want to have a pure fifth in your scale to fit with the harmonic series. Fortunately there is a scale that not only contains a perfect fifth but is actually constructed entirely out of perfect fifths and their octaves.

It is called the Pythagorean scale. This scale is used quite commonly nowadays by spiritually awakened music producers because it does not sound very different to a normal equal temperament scale, and so is still good to play normal music on. The truth is that our modern day equal temperament scale is actually based on the Pythagorean scale so it is not really that strange that they sound almost exactly the same.

The basic musical difference between them is that an equal temperament scale with its evenly spaced notes will sound the same in any key while the Pythagorean scale sounds more harmonious than equal temperament in some keys and a bit out of tune in others. I will now explain as best as I can why this is so and how this scale came to be:

Pythagoras

Pythagoras was born around 570 BC on the island of Samos, because it was so long ago details of his life are hard to come by. To make matters worse he did not write his ideas down so what we do know about him was written hundreds of years after he died. He is said to have traveled to various places including Egypt and Babylon where he studied in various mystery schools before setting up his own sect in Croton, Greece. It was these “Pythagoreans” who much later after the death of Pythagoras himself influenced Socrates and his students Aristotle and Plato to follow a similar path. This is important to us because these people formed the basis for western civilization as we know it today.

Pythagoras had many very interesting ideas, for example he believed that higher vibrational beings of extreme intelligence existed on other higher vibrational planets, the highest ones being nonphysical almost like light. He also believed in reincarnation and thought that you should not become too attached to earthly things so that you could break the cycle of earthly reincarnation and move up to a higher reality in your next life.

He also believed that all the planets emitted sounds as they moved through space and that these sounds made a perfect harmonic chord like a giant monochord, which as you should know plays only the harmonic series over a single root note.

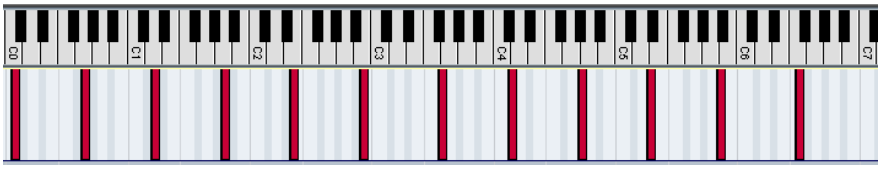
He called this sound “the music of the spheres”.

It is said that when he developed his music scale, he used a single-stringed monochord with one fret that could be moved to divide the string into the different fractions. The first thing he did was to make the string half its length and in doing this he discovered the octave, then he took that same string and cut off a third of what remained discovering the perfect fifth.

He then divided the string more times and discovered the perfect divisions of the full harmonic series. Using these string lengths he constructed the perfectly proportioned pentagram (The symbol of his secret society) and within that he found the golden ratio.

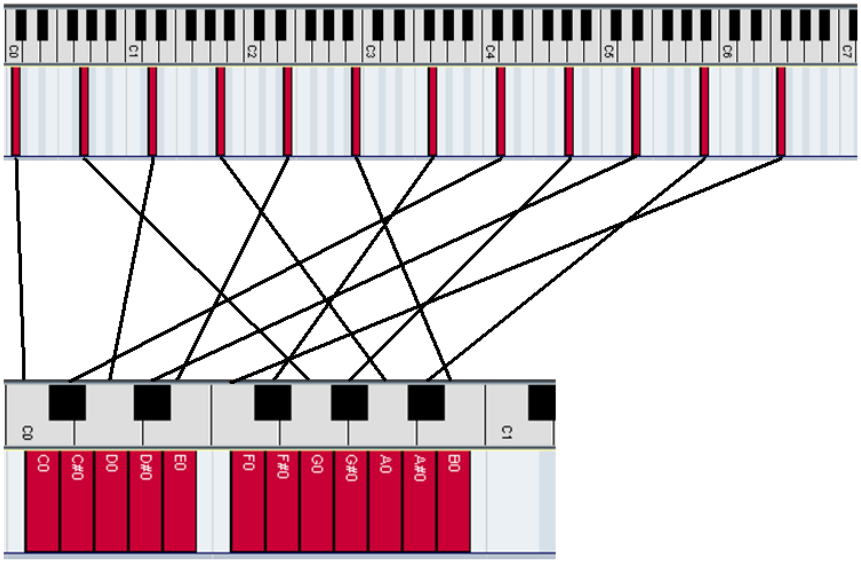
Stack of fifths

Now we return to Pythagoras making his scale using only this pure fifth. What he did was simple; he just repeated this perfect fifth eleven times making what we call a circle or stack of 5ths.



There is an obvious problem here though, and that is that the gaps between the notes are way too big to be a very good scale for music.

In response, Pythagoras apparently used the law of octaves bringing each note down by one or more octaves to make a nice scale that just happened to fit into exactly one octave and so could be repeated over many octaves making the full piano scale.



The next image shows same thing but with Hz frequencies:

The middle row shows the frequencies of the original stack of fifths (1-2-9-27-81 etc).

This means that if you move one column to the right the frequency gets multiplied by 3 and if you move one column to the left it gets divided by 3 (pure fifths from left to right).

The horizontal row shows these frequencies over a few octaves, so when you move one row downward the frequency gets multiplied by 2 and when you move one row upward it gets divided by 2.

Stack of pure 5ths + Octaves											
C	G	D	A	E	B	F#	C#	G#	D#	A#	F
											345.9902
										230.6601	691.9804
										461.3203	1383.9609
									307.5469	922.6406	2767.9218
									615.0937	1845.2812	5535.8437
								410.0625	1230.1875	3690.5625	11071.687
							273.375	820.125	2460.375	7381.125	22143.375
							546.75	1640.2	4920.75	14762.25	44286.75
						364.5	1093.5	3280.5	9841.5	29524.5	88573.5
1	3	9	27	81	243	729	2187	6561	19683	59049	177147
2	6	18	54	162	486						
4	12	36	108	324	972						
8	24	72	216	648							
16	48	144	432								
32	96	288	864								
64	192	576									
128	384										
256											
512											

As you can see when you multiply a frequency by 3 the resulting frequency is actually more than an octave above your starting frequency, it is a musical fifth but an octave above a normal musical fifth. To fix this all we do is lower it by one octave to give us the actual musical fifth.

A person can use this chart to find the perfect fifth of any other frequency in the chart. Just move one number to the right (multiply by 3) and then one number upwards dividing the frequency by 2 and lowering it by one octave. In this way we can see that the perfect fifth of 256 Hz is 384 Hz and for 288 Hz it is 432 Hz.

The ratio for the perfect fifth is written as 3/2 and this chart makes it easy to understand why that is: the ratio 3/2 simply means that you multiply your starting frequency by 3, and then divide it by 2.

You may have noticed that A is 432 Hz and not the usual 440 Hz. This is not a random frequency, A = 432 Hz was the old reference pitch sometimes called "Verdi's A" that was used in some parts of the world before 440 Hz became the standard.

Below is a simple chart of the ratio based Pythagorean scale with the reference pitch set to A = 432 Hz. As you can see its frequencies are exactly the same as the ones marked yellow in the stack of fifths starting in C in the chart on the previous page.

Pythagorean scale A = 432 Hz	
A	216.0000 Hertz
A#	230.6601 Hertz
B	243.0000 Hertz
C	256.0000 Hertz
C#	273.3750 Hertz
D	288.0000 Hertz
D#	307.5469 Hertz
E	324.0000 Hertz
F	345.9902 Hertz
F#	364.5000 Hertz
G	384.0000 Hertz
G#	410.0625 Hertz
A	432.0000 Hertz

This Pythagorean scale is fairly useful for harmonic BPM and brainwave work. It has four nice frequencies with small numbers in the lowest octaves for brainwaves that synch with 4 BPM's which also have nice low numbers. All are good for entering of BPM and Hz settings in your music software with their limited decimal capacity and so are the first 4 numbers that I have given the name “magic numbers”.

4 Magic Numbers + Octaves			
C	G	D	A
1	3	9	27
2	6	18	54
4	12	36	108
8	24	72	216
16	48	144	432
32	96	288	
64	192		
128	384		
256			
512			
BPM	BPM	BPM	BPM
60	90	67.5	50.625
120	180	135	101.25

All 12 notes in the scale actually have their own ratios and they all work in the same way as the 3/2 fifth ratio described above, just multiply your “perfect prime” by the first number in the ratio and divide it by the second.

Formula for ratio 4/3 (perfect fourth)				
A				D
216 Hz	x 4 =	864 Hz	/ 3 =	288 Hz

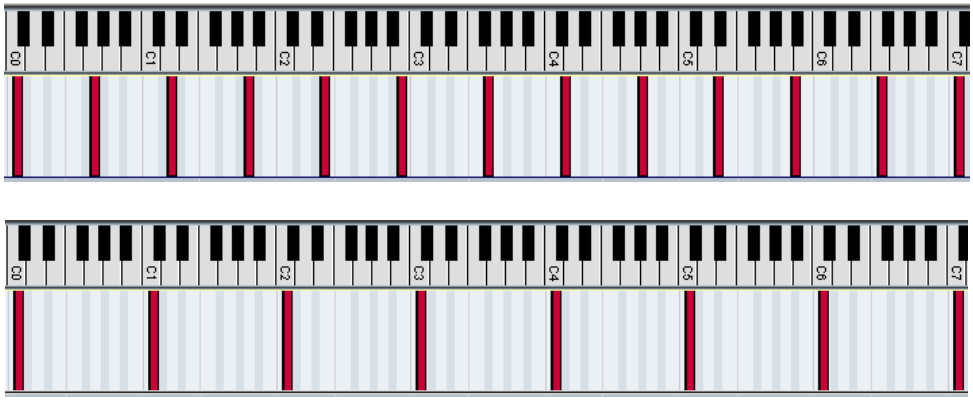
Here is a chart showing the Pythagorean scale and all its ratios. It is interesting to note that while the stack of 5ths started with C = 256 Hz, to get the same frequencies using ratios you must use an octave of A = 432 Hz as a root note (unison, perfect prime).

Note	Ratio	Ratio Name	Frequency
A	1/1	unison, perfect prime	216.0000 Hertz
A#	2187/2048	apotome	230.6601 Hertz
B	9/8	major whole tone	243.0000 Hertz
C	32/27	Pythagorean minor third	256.0000 Hertz
C#	81/64	Pythagorean major third	273.3750 Hertz
D	4/3	perfect fourth	288.0000 Hertz
D#	729/512	Pythagorean tritone	307.5469 Hertz
E	3/2	perfect fifth	324.0000 Hertz
F	6561/4096	Pythagorean augmented fifth	345.9902 Hertz
F#	27/16	Pythagorean major sixth	364.5000 Hertz
G	16/9	Pythagorean minor seventh	384.0000 Hertz
G#	243/128	Pythagorean major seventh	410.0625 Hertz
A	2/1	octave	432.0000 Hertz

Pure ratio scales are really based on the harmonic overtone series. To calculate the harmonic series of any frequency you must multiply it by the whole numbers 1,2,3,4,5,6,7 etc. This means that the first number in each ratio tells you what harmonic that frequency was based on before you divided it by the second number to get the final frequency. (B is based on the 9th harmonic while C is based on the 32nd harmonic).

Pythagorean error

The Pythagorean scale may seem perfect but it actually has a strange problem, this problem is so well known that it has its own name: the "Pythagorean error". If you look at a stack of 12 octaves and a stack of 7 fifths on a normal tuned piano (pure octaves but not pure fifths) you will find that a stack of 7 octaves and 12 fifths eventually end up on the same note again, that high C on the far right of the chart below (C7).



Well this is not the case with pure fifths and pure octaves together. A stack of octaves (2/1) and a stack pure fifths (3/2) never meet up, they come close but the frequencies are slightly off when you get to the same C7.

In the next graph I extend the Pythagorean stack of pure fifths by one more fifth after the top F to reach the same C as the first one again (full circle of fifths). You can see that while C is 512 Hz in the bottom left corner, the same C in the top right corner is now 518.9853 Hz and not 512.0000 Hz in that same octave.

Stack of Pure 5ths + Last C												
C	G	D	A	E	B	F#	C#	G#	D#	A#	F	C "should" be 512 Hz
												518.9853
											345.9	1037.9707
										230.6	691.9	2075.9414
										461.3	1383.9	4151.8828
									307.5	922.6	2767.9	8303.7656
									615.0	1845.2	5535.8	16607.531
								410.0	1230.1	3690.5	11071.6	33215.062
							273.3	820.1	2460.3	7381.1	22143.3	66430.125
							546.7	1640.2	4920.7	14762.2	44286.7	132860.25
						364.5	1093.5	3280.5	9841.5	29524.5	88573.5	265720.5
1	3	9	27	81	243	729	2187	6561	19683	59049	177147	531441
2	6	18	54	162								
4	12	36	108	324								
8	24	72	216									
16	48	144	432									
32	96	288										
64	192											
128												
256												
512												

The first 4 fifths and their octaves are very pleasing numbers with good BPMs and low brainwave frequencies, but it seems that as you go higher up with the stack of pure fifths the frequencies for the scale's higher notes just get more and more messy with decimals. This drift creates large ratios and disharmony between some of the notes in the final reduced scale, these bad notes are called “wolves”. To fix these wolf notes people make various adjustments, like compressing one or two of the 5ths in the middle of the stack or using other pure harmonies to replace them.

This is one such scale, it is a good scale to try if you are just starting to experiment with micro tuning because it sounds good in any key while still having many pure 5ths and other harmonic intervals.

Pythagorean Variation:

```
 0:  256.000000 Hertz
 1:  271.500000 Hertz
 2:  288.000000 Hertz
 3:  305.500000 Hertz
 4:  324.000000 Hertz
 5:  341.333333 Hertz
 6:  362.000000 Hertz
 7:  384.000000 Hertz
 8:  407.300000 Hertz
 9:  432.000000 Hertz
10:  458.200000 Hertz
11:  486.000000 Hertz
12:  512.000000 Hertz
```

This drift problem is quite strange. If you look higher up the stack of 5ths, at E = 324 Hz for example you will see that this frequency has bad low octaves for brainwaves. I think that 320 Hz would be more fitting for reasons I will now explain.

324 Hz + Lower octaves (Pythagorean E)	320 Hz + Lower octaves (Ptolemy E)
162	160
81	80
40.5	40
20.25	20
10.125	10
5.0625	5

Firstly, the harmonic BPM for 324 Hz is 151.875 BPM whereas for 320 Hz it is a nice round 150 BPM. Also 320 Hz has very special low octaves with 5 Hz being a good one to look at. 5 Hz sits right after 1, 2, 3 and 4 in the harmonic series so 5 Hz is the fifth harmonic of C = 1 Hz. If C = 1 Hz then a few octaves higher the same C = 256 Hz. E = 320 Hz is a pure major third of C = 256 Hz with nice ratio of 5/4, smaller than the Pythagorean major third which has a ratio of 81/64.

If creating pure harmony it is all about ratios then it would seem obvious that using harmonic series based whole number ratios to get all the notes for your scale might work better than a stack of fifths.

There are actually people doing this already, they call it "just intonation". One form of just intonation is the art of making a scale with the lowest possible whole number ratios while still getting a scale that sounds good for use in music. Whole number ratios automatically send you in the same direction as the harmonic series because the harmonic series is based on the same whole divisions. This is the path of least resistance in physical vibration and also the path of least confusion and decimal places in mathematics, which is good because it makes all the calculations so much easier.

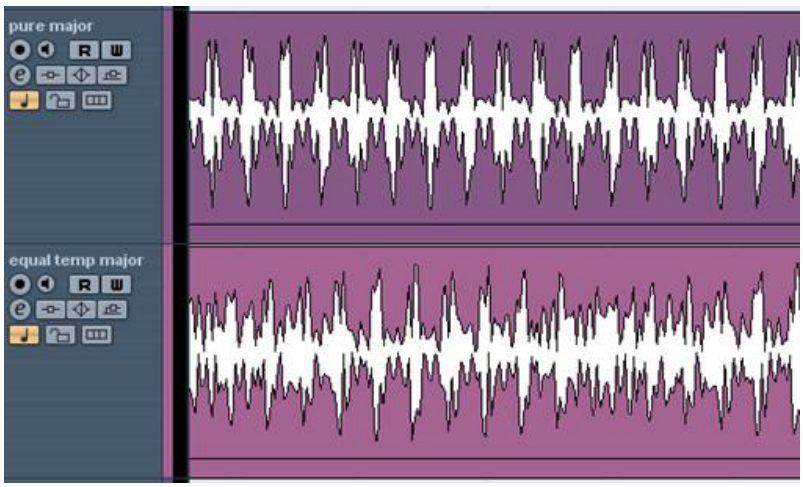
Ptolemy's Just Intonation scale

When you attempt to find the path of least resistance by using the best / smallest harmonic based ratios, the actual effect on the sound of your music will be very good. As you may remember from the chapter on binaural beats, when two sounds are slightly out of tune they create a wobble. Well, the same thing applies to notes in a scale.

A pure fifth with the nice whole ratio of 3/4 or pure major third with a ratio of 5/4 will create no disturbing wobbles when played with its root note, while with an equal temperament major third and its irrational ratio there will be more out of time wobbles.

These wobbles are called beats in the tuning world too. They are the same as monaural beats and will entrain against what you are trying to achieve if they are not in whole number harmony with your “perfect prime”.

The images below are both of a C major third played using the same sound on the same synth. The top one is a pure major third while the bottom one is a normal equal temperament major third, the lower one is messier because the ratios between the notes are not whole numbers and so there are more random “beats” and “wobbles” making the sound more unstable.



It seems that nature likes to follow this path of least resistance, like water spiraling down a drain. This would explain why nature uses harmonics like a pure major third or pure fifth, not an equal temperament major third and fifth which would have impossibly long ratios and would be like water flowing along an impossible path. The whole idea of pure ratios and just intonation was actually based on the harmonic overtone series in the first place. This series has the most pure intervals and so it is the most harmonic / beat free set of frequencies.

Remember that even single tones are made of sine waves arranged according to this inward spiraling harmonic series, so this is definitely the right direction for finding sweet sounding scales and creating more internal harmony in your music.

I have spent years looking for scales with nice round numbers to use in brainwaves and number work. After much searching I still have not found a better one than the one I am about to describe, I first found it amongst the preset scales that come with the tuning software "Scala" under the name “Ptolemy’s intense diatonic”.

Ptolemy

The Ptolemy scale is named after Claudius Ptolemy who was born in c 90 AD, he was a mathematician, astronomer, geographer and astrologer. He lived in Alexandria in Egypt where many of his writings were kept in the great library of Alexandria, his work and that of Pythagoras influenced our western civilization to a large degree.

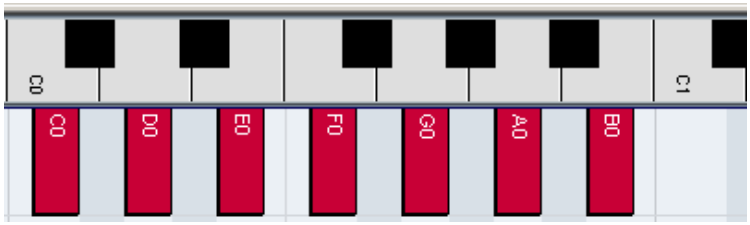
There are a few versions of this scale in the "Scala" presets, but I like one in particular. It is called "Ptolemy's intense diatonic" and it has very small pure ratios that are in perfect harmony with the harmonic series as you can see in the next image. It is really just a standard pure just intonation scale, but I will refer to it as the "Ptolemy scale" since he was one of the first to discover it and because there are just too many variations of the pure just intonation scale that have no actual names.

Just intonation does not actually refer to a specific scale at all, it refers to a method of making scales that is based on the harmonic series (first number in ratio) re-arranged via a whole number division (second number in ratio).

Ptolemy Scale		
Notes	Ratios	Ratio names
C	1/1	Unison, perfect prime
D	9/8	Major whole tone
E	5/4	Major third
F	4/3	Perfect fourth
G	3/2	Perfect fifth
A	5/3	Major sixth
B	15/8	Classic major seventh
C	2/1	Octave

This scale also sounds a bit out of tune in some keys while sounding better than even the Pythagorean scale in the same key as its reference pitch. So this scale is not the best for full classical or music with many key changes, for that I would use the Pythagorean scale or equal temperament. This type of scale is better for brainwave work or music with few key changes just like so much modern electronic music of today is made.

As you can see this scale only has 7 notes, the 7 notes that make a major scale:



(do - re - mi - fa - sol - la - ti)

There is a 12 tone version of this scale, it is exactly the same with the extra black notes. For now however I will only work with the 7 tone Ptolemy scale explaining it's very cosmic meaning and move to the 12 tone version later in this chapter.

So now that we have chosen a scale, all we need is a better reference pitch than the default A = 440 Hz so that we can look for our 4 magic and other geometric numbers that we can then use in our decimal limited audio software. Remember that with a pure scale the notes are not equally spaced. So if for example you use G = 384 Hz as reference pitch you will get 216 Hz for your "A", if however you use A = 216 as reference pitch you will get 388 Hz for G and not 384 Hz. So using each of our 4 "magic" numbers as reference pitch or "perfect prime" in turn will give us slightly different frequencies for some of the other notes.

I have tried every possible reference pitch with this scale and found only 2 (so far) that will give you all 4 of those useful / magic frequencies. They are G = 192 Hz and its pure major third of B = 120 Hz. 120 Hz is one octave above 60 Hz and 192 Hz has 12 Hz as one of its low octaves.

The fact that the numbers 12 and 60 work so well as a just intonation perfect prime is very interesting. Mathematics based on 60 and 12 originated with the ancient Sumerians in the third millennium BC and in still used today to measure things like time (60 sec = 1 min), sizes (12 inches = 1 foot), angles and geographic co-ordinates.

Out of these two frequencies I found 192 Hz to have better / smaller numbers in some of the lower octaves for brainwave / pc work and much better harmonic BPM's, so I will use that for the rest of this chapter. I will however re-visit 60 Hz and also look at 360 Hz as reference pitches for this scale later in this book as they both have equally amazing properties.

As you can see in the next chart all 3 of these frequencies (12, 60 and 360) are in the scale when the reference pitch is set to G = 192 Hz, so using any of them as ref pitch will still be within the same number matrix only making minor changes to some of the other notes in the scale. I see this number matrix as being rather complex. It is constant but it also changes slightly depending on where you are standing or where your current "perfect prime" is.

With 192 Hz as reference pitch this scale is so good that you now have 7 "magic numbers" all with useful lower Hz for brainwaves and good harmonic BPM's to go with them, a thing that is not as common as you may think.

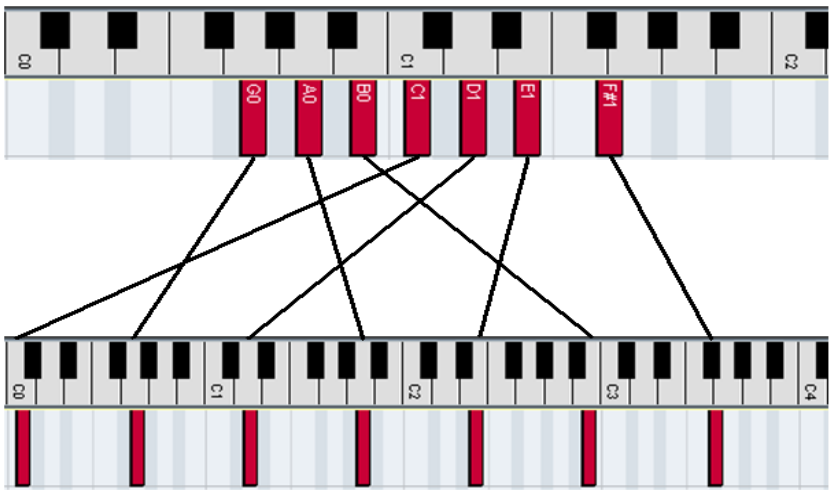
Just intonation scales do sound best in there root key, so this scale will sound best in G. If you want the best harmony in another key, then you should set your reference pitch or perfect prime to match the root key of your song.

You can find a mathematically useful number for this by using the frequency for that note as it is in any of the "Ptolemy" scales in this book, this will shift the matrix slightly so that all the notes resonate perfectly with the root frequency of the music. The 12 tone version later in this chapter has even more to choose from but for now we will stick with the 7 to keep things simple and make the charts easier to look at.

Ptolemy Scale in G = 192 Hz													
Notes	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz	BPM
G	384	192	96	48	24	12	6	3	1.5	0.75			90 180
A	432	216	108	54	27	13.5	6.75	3.375					50.625 101.25
B	480	240	120	60	30	15	7.5	3.75					56.25 112.5
C	512	256	128	64	32	16	8	4	2	1	0.5	0.25	60 120
D	576	288	144	72	36	18	9	4.5	2.25				67.5 135
E	640	320	160	80	40	20	10	5	2.5	1.25			75 150
F#	720	360	180	90	45	22.5	11.25						84.375 168.75

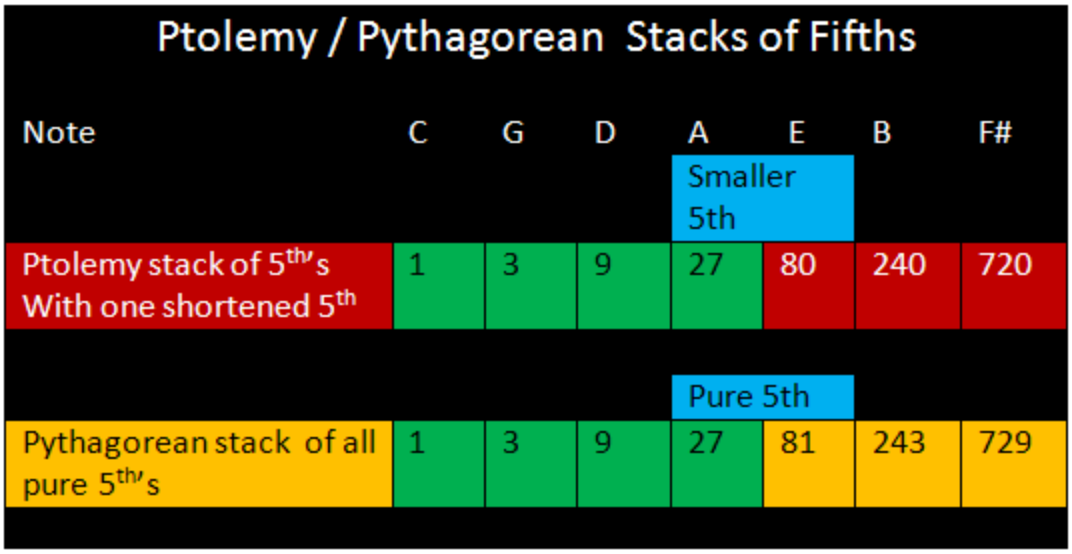
In the same way that a Pythagorean scale is made from a stack of fifths so the Ptolemy scale can also be broken down backwards into a stack of (not all pure) fifths by simply raising or lowering the octave of each note a certain number of times.

Even though the Pythagorean scale is generated from the reference pitch of A = 432 Hz and for the Ptolemy scale it is G = 192 Hz, both can be expressed as stacks of fifths containing exactly the same frequencies as they do in scale form but with both starting in C = 1, 2, 4, 8, 16, 32, 64, 128, 256…Hz.



The following image contains the first seven fifths from a stack of pure fifths (Pythagorean scale) and below it the first seven fifths from the Ptolemy stack of fifths. You can see that the first 4 frequencies in a stack of fifths starting with C made from the Ptolemy scale in G are exactly the same as the first four fifths in the stack used to construct the Pythagorean scale in A, while the last three are slightly different.

Both start out as a stack of pure fifths, but then when you get to E there is a shift. In the Ptolemy scale the next fifth (E) becomes that nice frequency of 80 / 320 Hz instead of 81 / 324 Hz like it is in the Pythagorean scale, the two notes in this fifth are a bit closer together than those in a pure fifth. After this smaller fifth the next three fifths in our stack (E, B and F#) make up another small stack of pure fifths.



So what this means is that while the Pythagorean major scale is made from a one long stack of pure fifths, the Ptolemy or just intonation major scale is made from 2 smaller stacks of also pure fifths with a "compression" in the fifth between A and E that brings them closer together than the interval of a pure fifth.

From this perspective the Ptolemy scale is really 2 small Pythagorean scales with a small compression in the middle between A and E that seems to "fix" the Pythagorean error, changing the messy end frequencies and ratio's in the Pythagorean scale into nice whole ones. 320 Hz (Ptolemy E) has the very useful number 5 as a lower octave while 324 Hz (Pythagorean E) has the unremarkable 5.0625 Hz in the same place. Esoterically speaking the number 5 = pentagram = golden ratio, so this shifted E does seem to be in a mathematically better and a more “cosmic” place.

Although it is being shifted downward bringing the notes closer together and making this fifth between A and E 'impure' and technically out of tune, you will find that if you play these two notes together they actually sound quite good.

All the frequencies in this just intonation/Ptolemy scale are mathematically and harmonically connected to their root, or reference pitch: G = 192 Hz with its low octaves of 3 and 12 Hz. This is the octave set that connects all of our 7 magic numbers together, but why G = 192 Hz? What is so profound about G or 192Hz? Well, from a number point of view it has very nice octaves that are useful and well used in all forms of math's and calculations, starting with the amazing numbers 3, 6, 12, 24, 48, 96, 192, 384, etc. (only this octave sequence starts with 3). It is also the perfect musical fifth of C = 256 Hz, with its octaves 1, 2, 4, 8 16, 32, 64, etc (only this octave sequence starts with 1).

G = 384 Hz also has an amazing connection to the color spectrum. Color is a vibration and can also be measured in Hz, if you measure light waves in Hz however you get very big numbers. This is because the visible light spectrum starts exactly 40 octaves above G = 384 Hz. This seems like a very good opportunity to use the law of octaves and to find audio tones that have similar properties with each color.

Light is actually measured in Angstroms with the center point for red being about 6870 Angstroms, the sum for converting Hz to Angstrom's is very complicated, which is why I use this online converter to do it for me: http://www.flutopedia.com/sound_color.htm.

So if G is 384 Hz then forty octaves higher would be 422212465065984 Hz, when converted to Angstroms this frequency fits nicely on the far left of the frequency band occupied by red in the Color spectrum.

Red is the first color on the light spectrum (the colors in a rainbow or prism) so red is the lowest vibrating color that human eyes can see. This sounds very good for a root frequency of a scale to me, the first note in a scale around which all the rest are arranged in harmony and so also the lowest vibrating note in the scale.

While I was discovering all of this, I noticed that there were 7 colors on the color spectrum chart and also 7 notes in my Ptolemy major scale. So I wondered what color I would get if I took the frequency of the highest note in this 7 tone scale (F#) which is just below the next G, and raised it by 40 octaves to get its octave harmonic color match. F#'s frequency is 360 Hz and raising it by 40 octaves gives you a frequency of 395824185999360 Hz. When converted to Angstroms this frequency is exactly on the top end of the light spectrum, on the far right in the frequency band occupied by the highest vibrating color that humans can see: violet.

I did this with all 7 colors and it turns out that the 7 color light spectrum covers exactly one octave which starts exactly 40 octaves above G = 384 Hz

Chakra work

There is another place where this color spectrum has been used for a very long time and that is in chakra work.

Chakras				
Number	Note / color	Chakra	Area on body	Connection
7	F# Violet	Crown	top of the head	Connection to spirituality
6	E Indigo	Third eye	Forehead	Intellect wisdom
5	D Blue	Throat	Throat.	Communication spiritual drive
4	C Green	Heart	Center of chest	Love , joy compassion
3	B Yellow	Solar plexus	Upper abdomen	Self-confidence willpower
2	A Orange	Sacral	Lower abdomen	Sexuality , well being
1	G Red	Root	Base of spine	Survival

Most chakra charts have exactly the same 7 colors in the same order with the same uneven spaces between them as the intervals between the 7 notes in a major scale. They also mostly say that red is the first chakra, the lowest vibrating or "root" chakra and that violet is the crown chakra, or the highest vibrating chakra.

So I made a possible chakra / audio frequency chart from the Ptolemy scale in G, matching all 7 frequencies in the scale to their matching color 40 octaves higher (multiply each frequency by 2 forty times).

In this chart all the horizontal color coded rows have the same frequencies but in different octaves (one row for each note in the scale).

7 tone Ptolemy Scale
With Chakra, Light, Audio and Brainwave Frequencies

Chakra	Color	Hz frequency falling in each color band	Hz Audio / Brainwaves	Harmonic BPM
crown	violet	791648371998720	720, 360, 180, 90, 45, 22.5, 11.25	168.75
Third eye	indigo	703687441776640	640, 320, 160, 80, 40, 20, 10, 5, 2.5, 1.25	150
Throat	blue	316659348799488	576, 288, 144, 72, 36, 18, 9, 4.5, 2.25	135
heart	green	562949953421312	512, 256, 128, 64, 32, 16, 8, 4, 2, 1, 0.5, 0.25	120
Solar plexus	yellow	527765581332480	480, 240, 120, 60, 30, 15, 7.5, 3.75	112.5
sacral	orange	474989023199232	432, 216, 108, 54, 27, 13.5, 6.75, 3.375	101.25
root	red	422212465065984	384, 192, 96, 48, 24, 12, 6, 3, 1.5, 0.75	90

There are many chakra charts that say that G = red is the base and that C = green is the heart chakra with all the other chakras just like in my chart, so this is not just my invention.

There are also many charts that say C is the root chakra, but I think those must be based on the piano. If however you are sure that C is the root chakra then it is not hard to shift your reference pitch and the color red to C, and work in the same way as you do with G = red as the root.

The following chart has more specific possible frequencies for each chakra that just came to me in a flash of numbers and connections. In this chart each color coded horizontal row contains frequencies and their harmonic BPM's, and each one also falls into a new octave and therefore a different brainwaves state.

The vertical column marked "brainwave frequencies" covers the first 7 octaves of brainwave frequencies and the column marked "audio frequencies" covers the next 7 octaves of audio above that one. I put the octaves side by side and calculated frequencies that are octaves of each chakra frequency and that also all fall into 14 successive octaves. Then it covers the full range of known audio, all the way from the slowest beats right up to the highest tones. Basically it is just a Ptolemy scale but with each successive note in the next new octave.

I think the "audio frequencies" column has a good possibility of containing the actual frequency or at least a good frequency range to use for each chakra. A nice bass tone for the base chakra and a very high whistle for the crown. Remember these are just possible frequencies, I can't say that they are exactly right! In fact I can't even prove that chakras exist at all. If you don't believe in chakras you can still make a light spectrum journey with a song for each color, still very interesting and very fitting with the universe and nature.

7 Tone Chakra Journey

Chakra	Brainwave State	Brainwave Frequencies	Audio Frequencies	Harmonic BPM
8	High gamma	96 Hz	G = 12288 Hz	180
7 crown	gamma	45 Hz	F# = 5760 Hz	168.75
6 Third eye	beta	20 Hz	E = 2560 Hz	150
5 throat	alpha	9 Hz	D = 1152 Hz	135
4 heart	theta	8 Hz	C = 1024 Hz	120
3 Solar plexus	delta	3.75 Hz	B = 480 Hz	112.5
2 sacral	Low delta	1.6875 Hz	A = 216 Hz	101.25
1 root	epsilon	0.75 Hz	G = 96 Hz	90

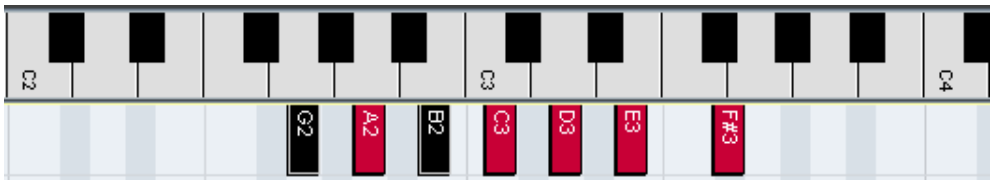
It is also good to remember that each color covers a wide area around that frequency, So even in music tuned to A = 440 Hz with the equal temp scale each note will still fall within that color band as will the same notes in the A = 432 Hz Pythagorean scale.

Here is a chart that you could use to quickly find the properties of any frequency. What the chart shows you is the range of each brainwave state (one octave each) and then it is extended into the audio range where it covers another 7 octaves fitting with our chakras perfectly. So if you want to know what properties a certain frequency has you can just find between which two numbers it falls, and then you will know its place in the audio spectrum.

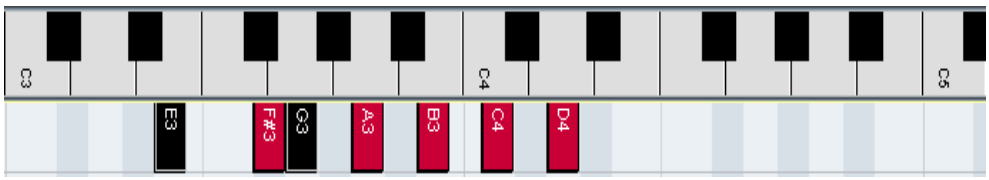
Cosmic Octaves

Chakras / Brainwave States	Range of each level
Ultrasound	16384 Hz +
Highest audible audio	8192 Hz - 16384 Hz
Audio / Crown	4096 Hz - 8192 Hz
Audio / Third eye	2048 Hz - 4096 Hz
Audio / Throat	1024 Hz - 2048 Hz
Audio / Heart	512 Hz - 1024 Hz
Audio / Solar Plexus	256 Hz - 512 Hz
Audio / Sacral	128 Hz - 256 Hz
High gamma / Bass audio / Root	64 Hz - 128 Hz
Gamma	32 Hz - 64 Hz
Beta	16 Hz - 32 Hz
Alpha	8 Hz - 16 Hz
Theta	4 Hz - 8 Hz
Delta	2 Hz -4 Hz
Low Delta	1 Hz - 2 Hz
Epsilon	0 Hz - 1 Hz

If you are making a song for each chakra, a good plan would be to make a 7 tone scale for each chakra using only the other 7 chakra tones for your notes. If you do this you will find that your scale for the base chakra, or G (starting on the note G and playing 7 notes upward using only other chakra tones) will be a major scale (see image below).



If you do the same thing starting in E you will get a minor one (see image below)



As you go through the chakras in this way you will get a different scale for each one, no two are the same giving each of the 7 chakras has its own unique "tune" or "mode"

The 7 Modes

The ancient Greeks, Pythagoras, Socrates and his students Aristotle and Plato were very interested in modes. They believed that each one mirrored an emotional state in man and that listening to certain modes would eventually change a person so that their emotional state matched that mode. They took it a bit far by wanting to ban certain modes and instruments that could play more than one mode, at one point they actually wanted to ban all musical innovation because they considered this freedom to be very dangerous ! In the end they accepted that there were two kind of music “educational” or “healing” and then fun or “drinking” music.

Modes are easy to understand when you play with only the white keys on a piano, although as you can see our chakra scale has one black note, F#. This is because the modes only fall on all the white notes when you start the first one in C and play them in the right order upwards from there. This explains why so many chakra charts say that C is the base or first chakra, because they base these charts on the piano and not the light spectrum. (I prefer the light spectrum because it is older than the piano) If you shift these modes upwards however, starting on G instead of C, then you have that one black note (F#) and no F in all 7 of them.

The following chart shows the modes and their names as they are normally arranged; starting with the Ionian mode in C. With this arrangement you only use the white notes on a piano, if you are one who believes that C is the base chakra and not G then you could use this to build your journey using the Pythagorean, Ptolemy or even equal temperament scales. You will notice however that the color spectrum is now arranged incorrectly, starting with green and ending with yellow.

The 7 Modes in C	
B Locrian	B, C, D, E, F, G, A, B
A Aeolian	A, B, C, D, E, F, G, A
G Mixolydian	G, A, B, C, D, E, F, G
F Lydian	F, G, A, B, C, D, E, F
E Phrygian	E, F, G, A, B, C, D, E
D Dorian mode	D, E, F, G, A, B, C, D
C Ionian mode	C, D, E, F, G, A, B, C

There is no rule that says they must be in these keys, you can play any mode in any key. It is only because they all fall on white notes that people always arrange them starting with C, below are the modes arranged in the same order but shifted to start with G as the Ionian mode instead of C. In this arrangement they use only our 7 chakra tones, all white notes but with the black note F# instead of the white note F. Set up in this way they match the color spectrum perfectly.

The 7 Modes in G		
F# Locrian	F#, G, A, B, C, D, E,	Crown
E Aeolian	E, F#, G, A, B, C, D,	Third eye
D Mixolydian	D, E, F#, G, A, B, C,	Throat
C Lydian	C, D, E, F#, G, A, B,	Heart
B Phrygian	B, C, D, E, F#, G, A,	Solar plexus
A Dorian mode	A, B, C, D, E, F#, G	Sacral
G Ionian mode	G, A, B, C , D, E, F#,	Root

As you can see, you now have a mode for each of your chakras. The Root chakra for example plays the Ionian mode which is identical to a natural Major scale, while the Third Eye chakra plays the Aeolian mode which is identical to a natural minor scale.

This is just one way of interpreting chakras and making interesting music, each chakra does not have to have these exact modes if it does not feel right to you.

I actually "discovered" modes when I was 10 years old. To make it easy to play piano I noticed that if you only use all 7 white keys on a piano and left out all the black ones (except for F#), then it was easy to play complicated sounding music full of key changes that always just sounded "right". It does not work without F# because you need it to complete the B minor and D major chords.

When doing this I was using F and that one black note F#. So I was really using the 7 modes starting in C with the added F# from the 7 modes in G, and so was really playing an 8 tone scale and not a 7 tone one (Try this on a piano to see how well it works).

As I mentioned, when you do this some rules are created: If your song is in A it will always be A minor, If your song changes from A to C it must change from A minor to C major and so on. This is because A minor is the relative minor of C Major, the same rule will apply if you want to start in G major, then E minor will be the relative minor to G Major.

To find which minor scale is related to a Major scale, you go to the sixth note of the Major scale.

For example: C Major + (c d e f g a) = A is the relative minor.

G Major + (g a b c d e) = E is the relative minor.

I would recommend trying this on a piano or even a virtual online piano then it is very easy to see how it works. Music which is created using this rule may sound so pleasing to humans because our brainwaves are divided onto octaves, one for each state. According to the laws of vibration that apply to so many matters of frequency, an octave will usually be divided into harmonic parts like the light spectrum is. This means that our brains are most likely hard wired to enjoy music that follows this same rule.

I have even met vocalists, guitarists and other instrumentalists who follow this rule. A stringed instrument such as a guitar as well as the human voice does not automatically lend itself to this like a piano does with its white keys to guide the way, and yet so many musicians still use this "rule" even though they have never actually even heard of it. This simple formula has been used in a large percentage of the greatest hits ever made (the great and most covered song in history "popcorn" being a very good example).

The fact that a piano is mapped around C and not G is actually quite nice because if you were making music in general, C = Heart chakra would be the frequency of choice to base your music on. The way a piano is mapped makes C the "go-to" key for playing a perfect major scale, if a piano was mapped to make G or the Base chakra the "go-to" key then would most music not perhaps be too primal?

It is also worthwhile to note that C (green) and G (red) are a fifth apart and so are very harmonious with each other. There are often debates that place red and green in the same place, as colors red and green are complimentary colors and are connected in a strange way: If you stare as a red object for a while and then look at a wall you will see a green after image and if you stare at a green object you will see a red one, so it is possible to assign C to red if you think in complimentary colors.

There are certain healers that use duel systems of healing based on complimentary colors / frequencies where they first determine the “orientation” of a person and then decide whether they must use a “red” or “green” system, some also use the complementary frequency (fifth) to heal a problem with the actual frequency.

In the harmonic series the fifth is the next harmonic after the octave, so when you hear C (green) you will usually hear G (red) clearly in its harmonics too. This is why you can make a G note on a piano ring by hitting the second C below it (the harmonic fifth in the C matches the frequency for the G).

It is a bit off with equal temperament but it still works showing us that harmonic entrainment is not only effective with octaves but also with overtones, and that it still works even if the frequency is slightly out.

7

So far in all of this there seems to be something special about the number 7. There are 7 musical modes and 7 notes in each mode, the eighth note being an octave (G to G) this note always has similar properties to the first note in the group and is also the first note in the next group of 7.

We also have 7 brainwave states over 7 octaves with the eighth (High Gamma) having similar properties to the first (Epsilon) and also being the first octave of another 7 octaves of audio ending with Ultra sound.

Although the light spectrum extends higher than we can see, the part that we can see consists of 7 colors that appear to fit with our 7 chakras and 7 tone major scale 40 octaves below. The bigger picture seems to indicate that the properties of many things repeat themselves over octaves which are in turn divided into 7 harmonic parts. If you break it down further these 7 parts are really made from 3 parts, the 3 primary colors and the 3 tone G major chord.

3 Primary Colors G, B and D = Major Chord	
G	red
G#	
A	orange
A#	
B	yellow
C	green
C#	
D	blue
D#	
E	indigo
F	
F#	violet

12

It seems like these 3 parts divided into 7 can be further divided to make 12 parts. The best way to explore this would be through the 12 tone version of the same scale that I mentioned earlier and the 12 colors that can be mixed from 7 using paint.

This scale / ref pitch combination has its own nice resonance since the reference pitch of 192 Hz has 12 Hz as one of its low octaves and the scale itself also has 12 tones. Having a reference pitch of 192 / 12 Hz means that this scale is harmonically based on and built around the number 12.

The original 7 tones are exactly the same as the 7 tone Ptolemy scale, but it has 5 more in between (black rows in chart below). It can also be found in the "Scala" presets where it is called "Basic JI with 7-limit tritone. Robert Rich: Geometry" (JI = Just Intonation) or as a .tun tuning file on my Facebook group page under “files”.

12 Tone Scale		
	Ptolemy 7 tone	JI 12 tone
G	192	192
G#		102.4
A	216	216
A#		230.4
B	240	240
C	256	256
C#		268.8
D	288	288
D#		307.2
E	320	320
F		345.6
F#	360	360

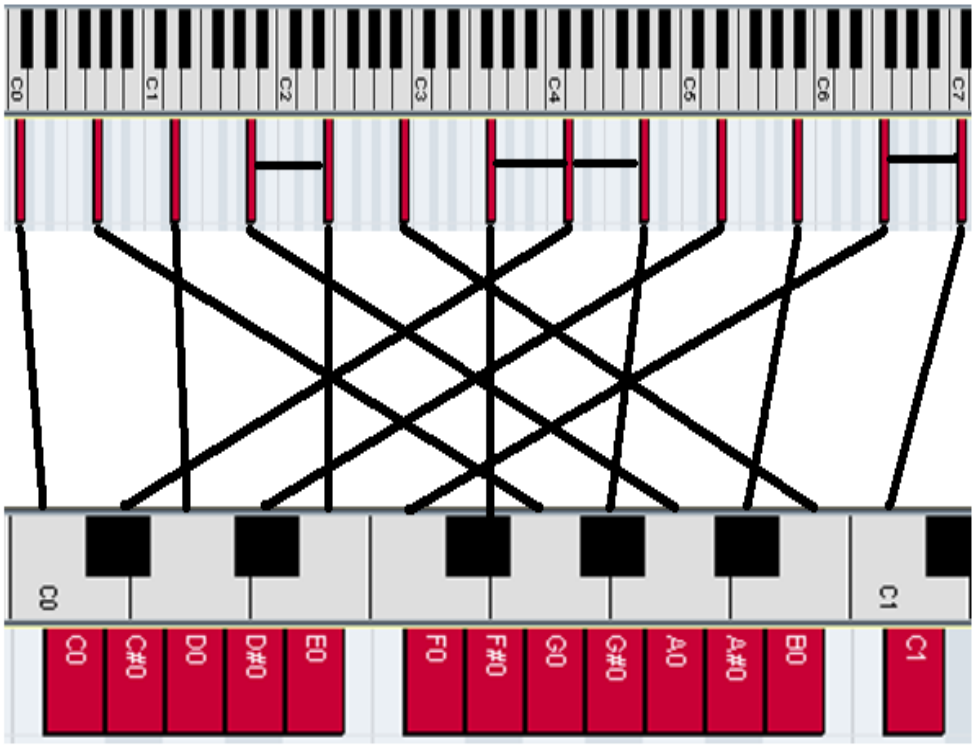
Here is an expanded chart with brainwaves and a possible 12 chakra sound journey based on this 12 tone version of the Ptolemy scale. The specific names and properties of the 5 new chakras (if they exist) are beyond me at this point, but the colors and possible frequencies seem easy to calculate using the 12 tone just intonation scale and the 12 hue color spectrum.

12 Tone Sound Journey

Note	Chakra	Audio Frequency	Brainwave State	Brainwave Frequency
G	*****	12288 Hz	High Gamma	96 Hz
F#	Crown	5760 Hz	Gamma	45 Hz
F	*****	5529.6 Hz	Gamma	43.2 Hz
E	Third eye	2560 Hz	Beta	20 Hz
D#	*****	2457.6 Hz	Beta	19.2 Hz
D	Throat	1152 Hz	Alpha	9 Hz
C#	*****	1075.2 Hz	Alpha	8.4 Hz
C	Heart	1024 Hz	Theta	8 Hz
B	Solar plexus	480 Hz	Delta	3.75 Hz
A#	*****	230.4 Hz	Low Delta	1.8 Hz
A	Sacral	216 Hz	Low Delta	1.6875 Hz
G#	*****	102.4 Hz	Epsilon	0.8 Hz
G	Root	96 Hz	Epsilon	0.75 Hz

This 12 tone version of the scale can also be deconstructed into a stack of fifths which also cover the 7 octaves of good audio (our brainwave frequencies occupy the 7 octaves below and ultrasound the octaves above). This stack of fifths has 3 "compressed" fifths (Marked by the horizontal lines in the next image) while the rest are all perfect fifths.

It is very interesting to note once again that both of the scales we have looked at, the Pythagorean scale with a ref pitch of 432 Hz and the Ptolemy scale with a ref pitch of 192 Hz can both be broken down into stacks of fifths that always start with C = 1 Hz.



All 12 notes of this scale are very good indeed as far as having a low decimal footprint for brainwaves and harmonic BPMs goes, with the root set to G = 192 Hz it actually becomes like a magic whole number festival. Take note that many of the same numbers that appear as BPM's on the right also appear as Hz one row higher on the left, showing how there is an interesting pure semitone harmony with that X 60 or / 60 conversion if you think of both numbers as Hz after the conversion.

12 Tone Ptolemy Scale with Lower Octaves and BPMS

Note	Ratio	Hz (Audio)	Hz (Audio)	Hz (Audio / Brainwaves)	BPM
G	1/1	384	192	96, 48, 24, 12, 6, 3, 1.5, 0.75	90 180
G#	16/15	409.6	204.8	102.4, 51.2, 25.6, 12.8, 6.4, 3.2, 1.6, 0.8, 0.4, 0.2, 0.1	96 192
A	9/8	432	216	108, 54, 27, 13.5, 6.75, 3.375, 1.6875, 0.84375	50.625 101.25
A#	6/5	460.8	230.4	115.2, 57.6, 28.8, 14.4, 7.2, 3.6, 1.8, 0.9, 0.45	54 108
B	5/4	480	240	120, 60, 30, 15, 7.5, 3.75, 1.875, 0.9375	56.25 112.5
C	4/3	512	256	128, 64, 32, 16, 8, 4, 2, 1, 0.5, 0.25	60 120
C#	7/5	537.6	268.8	134.4, 67.2, 33.6, 16.8, 8.4, 4.2, 2.1, 1.05, 0.525	63 126
D	3/2	576	288	144, 72, 36, 18, 9, 4.5, 2.25, 1.125, 0.5625	67.5 135
D#	8/5	614.4	307.2	157.6, 76.8, 38.4, 19.2, 9.6, 4.8, 2.4, 1.2, 0.6, 0.3, 0.15	72 144
E	5/3	640	320	160, 80, 40, 20, 10, 5, 2.5, 1.25, 0.625	75 150
F	9/5	691.2	345.6	172.8, 86.4, 43.2, 21.6, 10.8, 5.4, 2.7, 1.35, 0.675	81 162
F#	15/8	720	360	180, 90, 45, 22.5, 11.25, 5.625, 2.8125, 1.40625, 0.703125	84.375 168.75

It might look as if the new numbers like 102.4 and 230.4 could be smaller, maybe just 102 and 230. But the lower octaves of 102 and 230 are large irrational numbers while the lower octaves for 102.4 and 230.4 are nice and small, making them the most geometric and so better numbers for brainwave work etc.

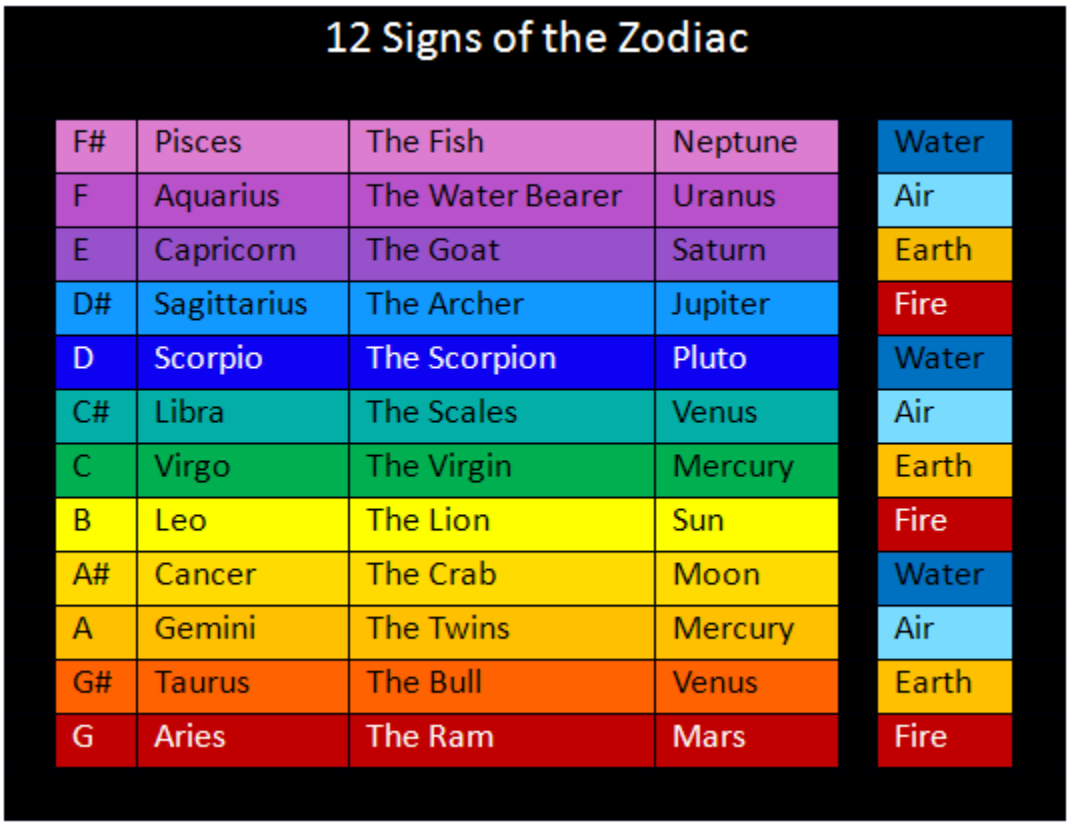
This really is an amazing scale/reference pitch combination. In fact, this makes the best 'go-to master chart' that I have made so far if you want to a reference pitch for a scale or harmonic frequencies for a brainwave program.

Remember that this kind of scale always sounds best when played in the same key as it's reference pitch, so if you want to make a song in D you may rather want to set your ref pitch to D = 288 Hz instead of G = 192 Hz. Most of the other notes in the scale will still be the same with some minor shifts here and there and the end result will be more musical. For other keys just use the chart above to select the frequency that matches the root note of your song and you will get a nice scale with a very low decimal count.

You might not agree with me that this set of numbers is so amazing, if not just try and convert all the notes in any other scales to their lowest Hz frequencies and matching harmonic BPM's and you will see that you just get many long irrational numbers.

Astrological music

In astrology people assign each of the 12 constellations/signs in the Zodiac to the 12 notes on a piano using the same 12 colors arranged for lowest vibrating (red) to highest (violet).


12 Signs of the Zodiac
F# Pisces The Fish Neptune Water
F Aquarius The Water Bearer Uranus Air
E Capricorn The Goat Saturn Earth
D# Sagittarius The Archer Jupiter Fire
D Scorpio The Scorpion Pluto Water
C# Libra The Scales Venus Air
C Virgo The Virgin Mercury Earth
B Leo The Lion Sun Fire
A# Cancer The Crab Moon Water
A Gemini The Twins Mercury Air
G# Taurus The Bull Venus Earth
G Aries The Ram Mars Fire

The musical interval from one Fire sign to the next is a Major third. The same applies to the gaps between any neighboring matching signs, Water to the next Water, Air to the next Air etc.

So these signs should go very well together: Aries to Leo, Taurus to Virgo, Gemini to Libra and so on. To work out more harmonic connections you can just play on a piano to see which pairs, trio's or even more notes sound good together to find harmonic astrological connections.

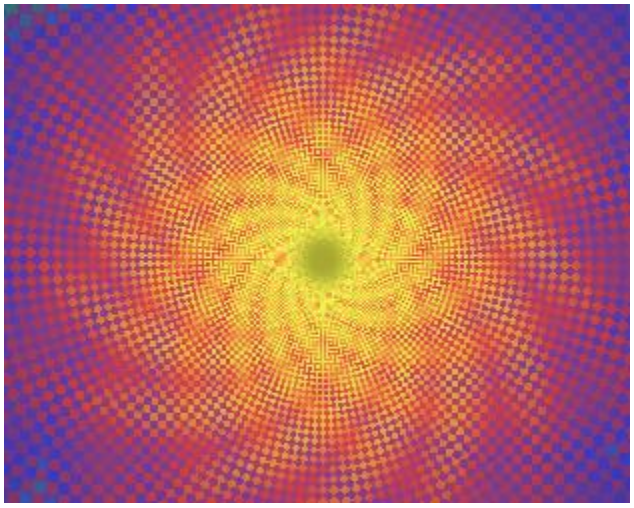
At the moment of your birth there will be certain planets lined up to various signs and their constellations, according to astrologers this also influences your life. These alignments can also be expressed musically using the chart above.

A major chord is a very harmonic chord, so this would be one to look out for when making connections with 3 points. For example two Fire signs that are next to each other will make a Major third and then to complete the chord all you need is the fifth, to locate that you go to the sign below the next Fire sign above: For example, G (Fire) to B (Fire) and then D (Water, which is just below the next Fire). The major chord in G consists of the notes G, B, D. So a major chord starting on Aries would be Aries, Leo and Scorpio, and for Gemini it would be Gemini, Libra and Capricorn. You could also add an extra note / sign to make a 4 tone major 7th chord.

As I have said I am no astrologer, this is just how I break it down using the laws of harmony and music. I have however sent this chapter to a professional astrologer and she said it is all correct.

The major chord is actually very profound, it plays a major role in color, sound, music, geometry, astrology, the harmonic series, and as I recently discovered, also in another of nature's formulas:

The Fibonacci series



The Fibonacci series is a sequence of numbers that occurs frequently in nature. It can be seen in the arrangement of petals and seeds on flowers, in the spiral shape of snail shells and in the arrangement of branches and leaves on trees. It is the same spiral seen when water goes down a plug hole or when a strong hurricane forms around its eye, just as it is the same shape found in the spirals of galaxies and hair on people's heads.

As a number sequence, the Fibonacci series becomes easy to understand. You just take a starting number, for example the number one, and add it to itself, to get two.

Then add them together to get three: 1 + 1 = 2 and 1 + 2 = 3. Now you have 1 - 2 - 3.

Then just add the last two numbers together to get the next number: 2 + 3 = 5. That gives you 1 - 2 - 3 – 5, add the last two numbers again, 3 + 5 = 8 and so you can go on and on. The result will be 1 - 1 - 2 - 3 – 5 - 8 - 13 - 21 - 34 - 55 - 89 - 144 … it goes on forever, another infinite spiral growing exponentially bigger with each new number.

If you take any two of these numbers that are next to each other, for example 5 and 8 and use them for sides to make a rectangle, you will get a golden rectangle with the infinitely long golden ratio of 1.61803398875…… across its two sides. This is the ratio found in the pentagram, the harmonic series, in the structure of some music and also in the proportions of many ancient buildings like the Parthenon in Greece, the Great Pyramids of Giza and Stonehenge. The Fibonacci series is still used today by musicians, architects and artists to produce beautiful proportions that resonate with nature.

If you look at the seeds on a sunflower and many other plants that follow this amazing outward radiating shape, you will see a double spiral. If one side has 8 seeds or petals the other will always have 13 (each side always has two sequential numbers from the Fibonacci series).

There are many ways to build the Fibonacci series into the structure of music, the most common being to make an 8 minute long piece of music that has its main peak at 5 minutes (golden ratio). It could also have other important happenings or "drops" at 1, 2, and 3 minutes.

If you raise the Fibonacci series by a few octaves to get musical tones you will find all the frequencies of a type of inverted C major chord in the first 4 frequencies. The only difference in the chord is that E is one octave higher than the E in a normal major chord, for example E G# B to G# B E. You have 'flipped' the E one octave up, all the notes are exactly the same but the order is changed. So from a tonal perspective you could base your music on a pure major chord, as this is really the “sound” of the Fibonacci series before the numbers become too far apart to make musical sense.

Fibonacci Series

C	C	G	E	C
1	2	3	5	8
2	4	6	10	16
4	8	12	20	32
8	16	24	40	64
16	32	48	80	128
32	64	96	160	256
64	128	192	320*	512
128	256*	384*	640	
256	512			
512				
C	C	G	E	C

Major chord

In the image below I have done the same thing with the harmonic series. The horizontal rows show the harmonic series also over a few octaves, as you can see it contains the same frequencies for a C major chord. As I said, they are actually different types of inverted major chords but all you do to make them normal is to octave shift one note in each one (see frequencies marked with a * in chart).

The connection between the harmonic and Fibonacci series actually is pretty obvious. The Fibonacci series = 1-1-2-3-5-8-13… and the harmonic series = 1-2-3-4-5-6-7-8-9-10-11-12-13… so the harmonic series really contains the entire Fibonacci series hidden within its harmonic overtones. Remember that you can start either of these series with any number or frequency, I just used 1 Hz or “C” as the best example. If you start them with D = 288Hz instead you will get a D major chord, whereas starting with F# = 360 Hz will give you an F# major chord and so on.

It seems as if the pure major chord is very important in many seemingly unrelated things. It is the one factor that clearly shows us how just intonation, the colors of the light spectrum, our chakras, our brainwaves, the harmonic series and Fibonacci series are all in harmony with each other. This is quite profound as these things are basically the building blocks and structure maps for of our entire reality.

Music of the Spheres

After I discovered the Ptolemy scale and its magic numbers I was sure that these numbers must have more cosmic connections beyond what I had already found. So I thought it would be interesting to take a look at the natural rhythms of our planet to see if there were any connections there. For a start I decided to find out exactly how many seconds were in one day. Seconds seemed like a good measure to check first since all our sounds were measured in Hz (cycles per second).

Some people say that the second is just a random man-made measure, it is man-made but it is not random at all. The second was first defined as 1/86.400 of one solar day, and later in terms of the earth's orbit around the sun. Nowadays it is measured using atomic clocks that use the transitional rate of certain atoms to define the second using the fundamental properties of nature as a base of reference. I am not sure how all of this came to be, but it did.

So with my Ptolemy scale in hand, I went to Google's unit converters (seconds to hours, hours to days etc) and started looking for connections. I started with a 12 hour half day, this represents exactly half a turn in the earth's rotation. I was quite blown away to find that there were exactly 43200 seconds in 12 hours, and 86400 seconds in 24 hours or one full rotation of the planet. This actually makes perfect sense because the second was first defined as 1/86.400 of one solar day.

Now you may think that 43200 Hz is not in musical harmony with 432 Hz but it is. When you divide 43200 by 10 you get 4320, if you divide 4320 by 10 again you will get 432.

The tenth harmonic in the harmonic series is found by multiplying your fundamental frequency by 10, when reduced one octave this frequency becomes a pure major third in relation to the fundamental. So dividing or multiplying a frequency by 10, (adding or removing 0's) is the same as playing one octave + a pure major third higher or lower, which is a very musically pleasing and harmonious thing to do.

In mathematics a multiple or division of 10 is called a "decade" making 432 exactly two decades below 43200, along with the octave the decade is a very common and very harmonic unit used to describe audio frequencies and ratios.

Decades are often used when working with frequencies in audio equipment like amplifiers and equalizers. For example an amplifier or EQ will usually have a frequency band ranging from 20 Hz to 20.000 Hz which is exactly 3 decades, and also happens to cover full range of human hearing down to the last Hz.

After doing an extensive Google search / unit conversion session, I made this triple checked and verified chart with some of the more interesting seconds, minutes, hours, months and years that I found. My main aim was to see if any of the magic numbers from the Pythagorean or Ptolemy scales appeared, and they did, in a big way !

Natural rhythms	
60 seconds in a minute	
3600 seconds in an hour	1 hour = 60 min
7200 seconds in 2 hours	2 hours = 120 min
10800 seconds in 3 hours	3 hours = 180 min
14400 seconds in 4 hours	4 hours = 240 min
18000 seconds in 5 hours	5 hours = 300 min
21600 seconds in 6 hours	6 hours = 360 min
28800 seconds in 8 hours	8 hours = 480 min
43200 seconds in 12 hours = half rotation of planet	12 hours = 720 min
86400 seconds in 24 hours = full rotation of planet (1 day)	**1 day = 1440 min**
48 hours = 2 days	2days = 2880 min
72 hours = 3 days	3 days = 4320 min
96 hours = 4 days	4 days = 5760 min
192 hours = 8 days	8 days = 11520 min
240 hours = 10 days	10 days = 14400 min
384 hours = 16 days	
12 months = 1 year	
72 years = earths movement through one zodiac constellation	
2160 years = earths movement through one zodiacal age	
25,920 years = one great year (12 zodiacal ages) (25,920 divided by 60 = 432)	

Next is a chart of the Ptolemy scale for comparison to the chart above. Since all of this seems to be linked to the Sumerian 12 / 60 math system and since we have been using 192 Hz with the low octave of 12 for a reference pitch all of this time, I thought I would try to use 60 Hz as a reference pitch instead to see how that works for a change. 60 Hz is the frequency for B in this same scale with a ref pitch of G = 192 Hz and is the pure major third of G. So doing this will only change some notes by 1 or 2 Hz, most of them will stay the same (including G which will still consist of 12 Hz and its octaves).

As you can see by the highlighted frequencies in the next image, a 60 Hz ref pitch fits very well with those natural cycles. I marked some important numbers with colored blocks but there are many more.

Ptolemy scale in B = 60 Hz									
B	60	120	240	480	960	1920	3840	7680	15360
C	64	128	256	512	1024	2048	4096	8192	16384
C#	67.5	135	270	540	1080	2160	4320	8640	17280
D	72	144	288	576	1152	2304	4608	9216	18432
D#	75	150	300	600	1200	2400	4800	9600	19200
E	80	160	320	640	1280	2560	5120	10240	20480
F	84	168	336	672	1344	2688	5376	10752	21504
F#	90	180	360	720	1440	2880	5760	11520	23040
G	96	192	384	768	1536	3072	6144	12288	24576
G#	100	200	400	800	1600	3200	6400	12800	25600
A	108	216	432	864	1728	3456	6912	13824	27648
A#	112.5	225	450	900	1800	3600	7200	14400	28800
B	120	240	480	960	1920	3840	7680	15360	30720

With 60 Hz as reference pitch it even has some of the higher numbers like 11520, 4320 and 14400, some of which were missing with 12 Hz as ref pitch. I love the way this scale reveals more and more when you use one of its other notes as a new reference pitch, it is almost like a lens to view a number matrix that is fixed and yet has many slight variations depending on your reference point or reference pitch.

Sacred Geometry = Harmonic Geometry

Here is a link to an amazing video called "Sonic Geometry: the language of frequency and form" by Eric Rankin and Alanna Luna that seems to agree with all of this:

http://www.youtube.com/watch?v=FY74AFQl2qQ

In this video Eric Rankin makes an interesting discovery: If you take the numbers of degrees in various sacred geometry forms and use them as Hz frequencies, you will find all the frequencies for a pure F# major chord over and over again.

Pure F# major chord found in sacred geometry			
note	2-D shapes	3-D Shapes	Flower of life
F#	Triangle 180	Tetrahedron 720 (4 triangles / pyramid)	1 Circle 360
F#	Square and circle 360		2 circles 720
C#	Pentagon 540 (5 sides)	Cube 2160	3 circles 1080
F#	hexagon 720 (6 sides)	Octahedron 1440 (8 triangles)	4 circles 1440
A#	Septagon 900 (7 sides)	Icosahedron 3600 (20 triangles)	5 circles 1800
C#	octagon 1080 (8 sides)		6 circles 2160

It is not just a major chord found here; it is actually the harmonic series:

180-360-540-720-900-1080 = harmonic overtones of 180 (2D shapes)

360-720-1080-1440-1800-2160 = harmonic overtones of 360 (flower of life)

This fits exactly with everything in this book, (the harmonic overtone series and its pure major chord found in so many things and so on).

Since this F# has a frequency of 360 Hz which is the same frequency as F# in our Ptolemy scale with 12 Hz or 60 Hz reference pitch, I thought I might try it as reference pitch for the same scale. Then I would be able to see what other frequencies emerged in those slight variations that occur when you use another note from a scale as a reference pitch for that same scale.

360 degrees = a circle, which is another reason why thought that this would be a good ref pitch for a geometric scale. That choice worked well because this reference pitch adjusts the scale in such a way that you not only get that pure F# major chord, but also most of the other geometric frequencies in Allana and Eric's video. Obviously 432 Hz, 288 Hz, 192 Hz and most of our other "magic" frequencies are there too, as are most of the “Natural rhythms” frequencies.

The highlighted frequencies in the chart below are all from the sacred geometry chart above, the blue blocks and there octaves are notes that also occur in Eric's "factor 9" scale. (Watch the "Sonic Geometry" video)

Ptolemy scale in F# = 360 Hz

F#	reference	90	180	360	720	1440	2880	5760	11520	23040
G		96	192	384	768	1536	3072	6144	12288	25600
G#		101.25	202.5	405	810	1620	3240	6480	12960	25920
A	Minor 3rd	108	216	432	864	1728	3456	6912	13824	27648
A#	Major 3rd	112.5	225	450	900	1800	3600	7200	14400	28800
B		120	240	480	960	1920	3840	7680	15360	30720
C		126	252	504	1008	2016	4032	8064	16128	32256
C#	fifth	135	270	540	1080	2160	4320	8640	17280	34560
D		144	288	576	1152	2304	4608	9216	18432	36864
D#		150	300	600	1200	2400	4800	9600	19200	38400
E		162	324	648	1296	2592	5184	10368	20736	41472
F		168	336	672	1344	2688	5376	10752	21504	43008

When Eric made the factor 9 scale using the sum 144 + 9 + 9 + 9 + 9 to fill one octave, he was really constructing what is known as a harmonic scale. A harmonic scale is made by using a portion of the harmonic series and repeating it over a few octaves to make a usable music scale. This is closer to the actual harmonic series than the Ptolemy / just intonation scale which is made from overtones divided by whole numbers.

Using selected overtones works well because with the full harmonic series, the overtones get closer and closer together as you go higher up. There are in fact more than 400 overtones between 20 Hz and 20000 Hz (more or less our hearing range), so as a music scale there are just too many notes near the top end to fit on any keyboard. The highest overtones are also so close together that it is hard to tell one from the next, this is a real waste of keys when you only have a few octaves on your keyboard.

The factor 9 scale is only based on 9 when it is in certain keys. I will however keep calling it the factor 9 scale for easy reference, even though it is really a harmonic scale made from overtones 16 to 32 in the harmonic series.

In the scale making software "Scala" you can generate harmonic scales with simple settings for "first" and "last" harmonic, it then generates a harmonic series but leaves out all the notes above and below the harmonics selected.

(There is a full chapter on how to use Scala later in this book).

The chart below shows you exactly how the factor 9 scale fits into the harmonic series. The long column on the right shows the harmonic series for 9 Hz (9 + 9 = 18 + 9 = 27…) while the bottom half shows the portion that makes the factor 9 scale repeated over 4 octaves to the right and left. There are more notes in the scale here than there are in the “Sonic Geometry” movie, showing you the full 16 tone octave.

Harmonic series for 9 Hz

Harmonic Number	Note Names	Blue lines separated by one octave.					
1	D		9				
2	D		18				
3	A		27				
4	D		36				
5	F#		45				
6	A		54				
7	C		63				
8	D		72				
9	E		81				
10	F#		90				
11	G		99				
12	A		108				
13	B		117				
14	C		126				
15	C#		135				
16	D	72	144	288	576	16 tones	
17	D#	76.5	153	306	612		
18	E	81	162	324	648		
19	F	85.5	171	342	684		
20	F#	90	180	360	720		
21	G	94.5	189	378	756		
22	G2	99	198	396	792		
23	G#	103.5	207	414	828	Factor 9	
24	A	108	216	432	864	Scale	
25	A#	112.5	225	450	900	In D	
26	B	117	234	468	936		
27	B#	121.5	243	486	972		
28	C	126	252	504	1008		
29	C2	130.5	261	522	1044		
30	C#	135	270	540	1080		
31	C#2	139.5	279	558	1116		
32	D	144	288	576	1152		

Because this is the harmonic series for D you will find that D will be the best root note for music making, and that you will need to make a new scale for music in other keys.

The factor 9 scale can also be expressed as ratios using any octave of “perfect prime” as a reference pitch and forgetting about its original 9 Hz harmonic base. In the two columns on the right I used 72 Hz and 144 Hz examples, (Both are octaves of 9 Hz).

Factor 9 scale ratios

Harmonic number	Note	Ratio	Ratio name	Hz	Hz
16	1 D	1/1	unison, perfect prime	72	144
17	2 D#	17/16	17th harmonic	76.5	153
18	3 E	9/8	major whole tone	81	162
19	4 F	19/16	19th harmonic	85.5	171
20	5 F#	5/4	major third	90	180
21	6 G	21/16	narrow fourth	94.5	189
22	7 G2	11/8	undecimal semi-augmented fourth	99	198
23	8 G#	23/16	23rd harmonic	103.5	207
24	9 A	3/2	perfect fifth	108	216
25	10A#	25/16	classic augmented fifth	112.5	225
26	11 B	13/8	tridecimal neutral sixth	117	234
27	12 B#	27/16	Pythagorean major sixth	121.5	243
28	13 C	7/4	harmonic seventh	126	252
29	14 C2	29/16	29th harmonic	130.5	261
30	15 C#	15/8	classic major seventh	135	270
31	16 C#2	31/16	31st harmonic	139.5	279
32	17 D	2/1	octave	144	288

If you look at the “harmonic number” column on the left you can see what harmonic each note is in relation to D = 9 Hz, and in the “ratio name” column you can see each harmonics musical name in relation to “perfect prime”.

In the “ratio names” column you can see that it is not too different from a Ptolemy or even an equal temperament scale with a pure major third and perfect fifth to make a pure D major chord. It is possible to play a harmonic version of any “normal” melody with this scale although it will always have a unique and beautiful sound.

The next chart shows the harmonic series and the same harmonic scales for G = 12 Hz. I used the correct octave matched colors for each tone and chose 12 Hz for a base because it is within the frequency range of the first color in the spectrum (red).

Starting with red shows us how the color spectrum fits into the harmonic series in an interesting way. If you start on harmonic number 4 and move down the chart the 3 primary colors (Pure G major chord) show up first, then you get identical repeating color spectrum with progressively more and more hues in each octave as you go higher up the series (Any color to the same color = 1 octave).

Harmonic series for G = 12 Hz

Harmonic Number	Note	Hz	3 Tones	8 Tones	16 Tones	12 Tones
1	G	12				
2	G	24				
3	D	36				
4	G	48	G Major Chord			Overtone Singing Scale
5	B	60				
6	D	72				
7	F	84				
8	G	96		Chakra Scale		
9	A	108				
10	B	120				
11	C	132				
12	D	144				
13	E	156				
14	F	168				
15	F#	180				
16	G	192			Factor 9 Scale	
17	G#	204				
18	A	216				
19	A#	228				
20	B	240				
21	C	252				
22	C	264				
23	C#	276				
24	D	288				
25	D#	300				
26	E	312				
27	E	324				
28	F	336				
29	F	348				
30	F#	360				
31	F#	372				
32	G	384				

The 8 tone “chakra scale” seems to show us that our chakras can be connected directly to the harmonic series. On the next page is a possible chakra chart based on this third octave of the harmonic series. (Please excuse slight variations in shades of the same color across my charts).

8 Chakras						
Number	Hz	Note	Color	Chakra	Area on body	Connection
8	180	F#	Violet	Seat of Soul	Above the head	Spirit, Higher self
7	168	F	Purple	Crown	Top of the head	Connection to spirituality
6	156	E	Indigo	Third eye	Forehead	Intellect, Wisdom
5	144	D	Blue	Throat	Throat.	Communication, Spiritual drive
4	132	C	Green	heart	Center of chest	Love , Joy, Compassion
3	120	B	Yellow	Solar plexus	Upper abdomen	Self-confidence, Willpower
2	108	A	Orange	sacral	Lower abdomen	Sexuality , Well being
1	96	G	Red	Root	Base of spine	Survival

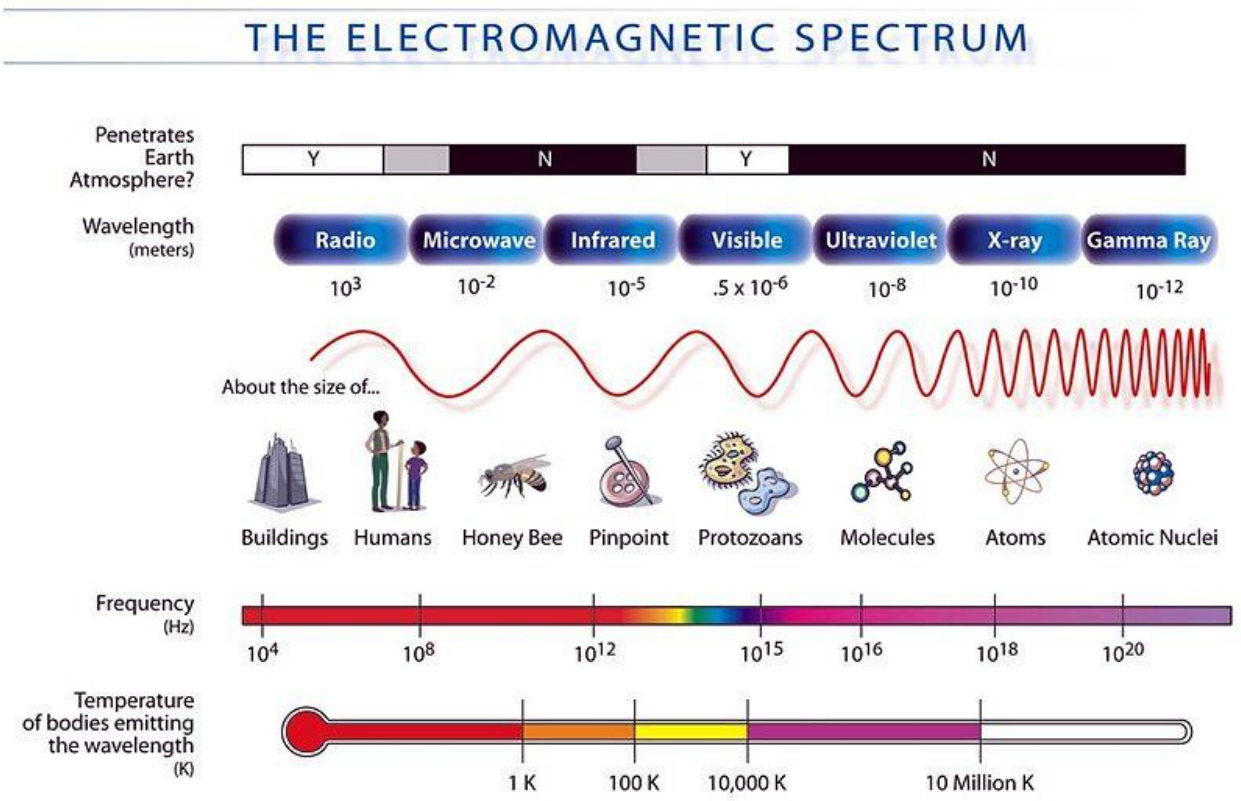
I am no chakra expert and only use them for a convenient guide, I prefer just to think of them as energy points or harmonic nodes. It makes sense to connect the lowest vibration (red) to the most primal things while connecting the highest vibration (violet) to the most spiritual, so I find the traditional chakra descriptions to be quite helpful for understanding rest of the spectrum. There are overtones above and below these 8 which could explain the stories of more chakras above and below these ones.

The frequencies for G, A, B, D and F# are the same as they are in the Ptolemy scale and in my other chakra chart, while C and E are slightly different. There is also an F in this scale while there was no F in my other 7 tone chakra scale. In the previous chapter on chakras and just intonation I found that using the 7 tone chakra scale, but with an added F was a quick and easy way to make great sounding music over many keys. So it is interesting how we are adding that same F as an extra chakra here to fit with the 8 overtones in the third octave in the harmonic series.

Many pianists and keyboard players use the equal temperament equivalent of this eight tone harmonic scale (C, D, E, F, F#, G, A, B) because it sounds great and uses the white the keys with only one black one (F#). A large percentage of the greatest music on earth uses the same intervals. You do not have to use only the white keys, this scale can be transposed into any key in which case you would need to use some of the black notes. Some musicians use this scale consciously while others seem to be doing it instinctively, this makes sense because people do seem to feel more comfortable with tones that mirror the intervals found in the harmonic series as closely as possible.

I think that the harmonic series is a great thing to base a music or healing system on because it is the most basic law that creates stability and harmony just about everything, and because we can measure its intervals very precisely using sound.

The way that each octave of the harmonic series in G mirrors the visible octave of the light spectrum is fascinating. The middle part of the next image marked “visible” shows the small band of visible light that we have been dealing with. I can’t help but wonder if the octaves above and below (radio, microwave, infrared, ultraviolet, x-ray and gamma ray) might not follow the same patterns as visible light and the harmonic overtones in audio do. If they do then we could use our understanding of harmony in sound and light to understand the things lie between, above and below them in the spectrum.



Cosmic Connections

Here are some interesting facts that I found on the web, there is much more but I only included what seemed to come from reliable sources and could be cross checked with other unconnected and also reliable-looking sources:

The Schumann Resonances that the earth generates start at 3 Hz and end on 60 Hz with a fundamental or peak at 7.83 Hz, as you know, 3Hz is an octave of 12 Hz and 60Hz is too is very much part of our scale work so far, so here we have even more harmony of the spheres.

Next fun fact: the moons diameter is within 1 mile of 2160 miles and the sun around which all of this revolves also seems to be tuned in, as its radius is almost exactly 432000 miles.

Further out is the planet Saturn, which is known as the timepiece of the solar system because its orbit is so constant and steady. Saturn takes exactly 864 of its years to complete one orbit of its procession, so half an orbit will take exactly 432 of its years.

Another thing I found was that 432 x 432 = 186624, the speed of light is approximately 186,291 miles per second in a vacuum…

All these measurements are approximate because nature modulates and is usually not fixed to an exact frequency.

As I looked deeper I realized that I was not the first person to have thought of this idea, there is plenty of evidence that many ancient and wise cultures have played music tuned to 432 Hz, 288 Hz and there harmonics, from Tibetan monks to forest shamans, ancient Egyptians and ancient Sumerians, Ptolemy, Pythagoras, Verdi, Mozart and many modern musicians still keeping this alive to this very day.

Sacred Sites

This same harmonic number system also seems to have been used by ancient cultures in the construction of many sacred sites, for example the builders of the Great Pyramid of Giza. Originally the Great Pyramid was covered with exactly 144000 casing stones most of which unfortunately seem to have been stolen at some point. There are also many examples the golden ratio in its design but the most interesting thing of all is that when you hit the kings “sarcophagus” the whole area echo’s at around 108 and 216 Hz with many higher softer harmonics including 432 Hz.

In England there is the ancient mystery of Stonehenge, its outer circle of stones is about 108 feet in diameter (108 is an octave of 432), both these sites are aligned with various important planets, the equinoxes and other cosmic happenings or entities.

A very interesting site to look into as well is Angor Wat in Cambodia, there are many examples of 432, 108, 144 etc in the structures and statues there. For an amazing sight type "Angor Wat" into Google earth's search bar and see for yourself how it lines up perfectly with the lat / long grid, this is a very interesting place indeed. There are many more examples of these magic numbers at these and many other similar sites, but I am not really a researcher of ancient buildings and architecture and so have not spent much time looking at all of these things.

These numbers are also used in many religions, for example the yogis who have strings of beads called "Shiva beads" that always come on strings with 108 beads, this means that if you see 4 yogis they should have exactly 432 beads between all 4 them. The "Kali Yuga" also is an important long time cycle in some Indian religions that lasts for 432.000 years. Even the Christians seem to know something because they come right to my door and tell me that exactly 144000 people will be chosen by God to save the world one day.

The Mayan's used these same numbers in their famous measures of time, in their time cycles, 1 Tun = 360 days, 1 Katun = 7200 days and 1 Baktun = 144000 days. The Sumerians used these numbers so much that I will not even start to list examples here.

I may be wrong, but it really seems to me as if the Mayans may have been using the same number system as the Sumerians, the Egyptians, the Greeks and many other ancient cultures. There really does seem to be a strange connection here, all these people using the same "cosmic" numbers with their connections to harmonics and planetary movements to count and measure things. The most obvious things that they left behind are the stone structures that often have these numbers in there proportions and are almost always aligned to various stars and planetary movements, especially sunset and sunrise on the equinoxes.

There are even some fairly modern cities and buildings that are still aligned in this way such as "Manhattanhenge" with its obelisk and aligned streets in New York, and the central oval obelisk area in the Vatican City. Both of these obelisks were originally from ancient Egypt and were brought to the west with great effort and at great cost. These are not the only obelisks that made this long journey; there are two more, one in London and another in Paris. This adds up to 4 obelisks in 4 of the modern world's greatest power centers that were brought from the old power center of the world where our culture began.

It seems like the original cultures, the Sumerians, the ancient Egyptians, the Mayans, the builders of Angor Wat in Cambodia, the builders of Stonehenge and many others around the world must have been connected with each other in some way. They all seemed to have the same interests, beliefs and ways of doing things, you could almost say for some time many thousands of years ago "everybody" was counting, measuring, building and surly also tuning music using these same magic numbers.

I am not really an expert historian, but it could be that just as we found the reference pitches of 12 Hz and 60 Hz to be the best for harmonic number work, so these ancient people may also have found that numbers based on 12 and 60 were more useful for making big calculations and measurements. (Something they clearly did a lot)

If they used this type of harmonic based system then they would always have ended up with “magic” numbers like 1440 or 4320 and not 1000 or 4000 for large calculations such as the amount of casing stones needed to perfectly cover a large pyramid. That could explain the 144000 casing stones on the great pyramid and all the other examples of these numbers in constructions that date back thousands of years.

I must wonder that since these numbers have such a close relationship with the Planets, the harmonic / Fibonacci series, the color spectrum and all these things, whether the numbers did not actually originate from people observing these natural phenomenon in the first place. It also makes we think that maybe we should observe these things more closely in the hopes of learning what they learned.

A big problem is that these people lived so long ago that there are plenty of theories going around and very little facts. What we do know for sure is that there must have been a huge global culture or cultures of pyramid / huge stone block builders that existed all around the world thousands of years ago. These beings were obviously far ahead of us in many fields such as astrology, astronomy, stonework and probably others too.

If you try and trace this all back we had the Greeks, Socrates and his students Aristotle and Plato, then before them, also in Greece and a great influence on their work we had Pythagoras who seems to have been the first to bring this knowledge to the west.

Pythagoras is said to have traveled from Greece to Egypt to study in their mystery schools after which he was captured by the Persians and sent to the city of Babylon in Mesopotamia which they had conquered and were ruling at the time. There he studied with the Chaldaeans of Babylon and the Magi of Persia before eventually returning to Greece with all of this information.

The Babylonian and Assyrian / Syrian civilizations grew out of the ancient Sumerian civilization, it is even said that the Sumerian civilization which pre-dates ancient Egypt by thousands of years may actually have influenced ancient Egyptian Culture. This could explain the many similarities between these two cultures which in themselves make it pretty obvious that they must be connected in some way or another.

Why this timeline is important is because our culture has been heavily influenced by the Ancient Greeks who in turn were heavily influenced by the Ancient Egyptians.

The one thing connecting all of these things is this number system, this matrix of mystery that keeps popping up over and over again.

These are the numbers of nature, harmonics and sacred geometry, expressing the path of least resistance in the vibrations of light, sound, atoms and other small vibrating particles that make up physical matter

The humans starts out as 1 cell, then 2, 4, 8, 16 etc (octaves)

Water down a plug hole and a spiral galaxy = 1-1-2-3-5-8-13-21 etc (Fibonacci series)

The harmonics in all musical tones = 1-2-3-4-5-6-7-8 etc (Harmonic series)

All three of these things are infinite spirals represented by the simplest number sequences. All of them are also in harmony with each other because they all use the same small whole numbers as a base, this proves that simple pure number sequences represent nature which always uses the same most efficient path of least resistance to do things, the same path needed to make easy low decimal calculations on a computer, hieroglyph or Sumerian clay tablet.

I discovered these numbers in my quest to find frequencies and scales with matching BPM's and low Hz brainwave frequencies. As you know I needed frequencies without any long infinite numbers that could easily be entered into decimal limited computers for my brainwave work. Only later did I find out that these most useful numbers for music harmony and its mathematics are also deeply connected to the earth, the cosmos and all of these ancient cultures.

Apart from making great sounding music, using these frequencies to learn about harmony, science and the cosmos has taught me so much that there is simply no way I will ever make music based on 440 Hz again. I now make music to reflect, imitate and express my respect for the universe around and inside of me.

How to tune Synthesizers

And Instruments

By now you must really want to know how to implement this in real life and how to tune actual instruments so that they are in tune with the cosmos. The word we use for this is kind of tuning is "micro-tuning", with micro-tuning you can play Factor 9, Harmonic, Pythagorean, Ptolemy / Just Intonation or any other scale you can think of.

If you play guitar, analogue synth or other instruments that can only play the equal temperament scale and cannot be micro-tuned, don't worry. Tuning your master tune to A = 432 Hz will get most of your notes to within 1 Hz of the same notes in the Pythagorean and Ptolemy scales while the rest of the notes will be very close:

	Equal Temp A = 432	Pythagorean A = 432	Ptolemy A = 432
A	216.0000	216.0000	216.0000
A#	228.8440	230.6602	230.4000
B	242.4518	243.0000	240.0000
C	256.8687	256.0000	256.0000
C#	272.1429	273.3750	268.8000
D	288.3254	288.0000	288.0000
D#	305.4701	307.5469	307.2000
E	323.6343	324.0000	320.0000
F	342.8786	345.9902	345.6000
F#	363.2673	364.5000	360.0000
G	384.8682	384.0000	384.0000
G#	407.7537	410.0625	409.6000
A	432.0000	432.0000	432.0000

So there is still plenty of magic with “normal” equal temp tuning adjusted to A = 432 Hz.

A = 432 with an equal temperament scale is the preferred tuning method used by many live bands that tune to 432 Hz, in fact with very melodic music with many key changes equal temp tuning actually sounds better than the Pythagorean and harmonic scales. The equal temp scale is actually based on the Pythagorean scale so they really are not that much different when they both have the same reference pitch.

It all depends on what you music you are playing, pure scales are better for music with few key changes, brainwaves, number work and such things while equal temp is often better for multi-key music making. As for the 1 or 2 Hz difference from the pure numbers that you get in equal temp tuning, if you are an "as above so below" person who wants to tune music to the earth's natural cycles then you need not worry. All of the earth's movements modulate and change slightly from time to time, so all these measurements are estimated anyway.

If you want to go all the way with the full Ptolemy or Pythagorean scale then you should learn to use the amazing free scale making software called "Scala" which can be downloaded from this link: http://www.huygens-fokker.org/scala/index.html There are also many tutorials, links and information there on the "Scala" web page, so it is a very a good place to read and learn more about micro-tuning.

With Scala you can generate scales like the Pythagorean, just intonation and Harmonic scales. You can also export them in a variety of different formats like bulk dump midi files and .tun files that can be loaded into various hardware and software synths.

If you don't feel like learning to use "Scala", you can simply download the pre-made tuning files for A = 432 Hz Pythagorean scale, the G = 192 Hz Ptolemy scale and others from my Facebook group called "Life, the Universe and 432 Hz",
link: https://www.facebook.com/groups/345636055517218/ After that, you just need to read the "how to load .tun files into synths" section further on in this chapter.

How to use Scala

First I will explain how to make the scales and export them as various formats for various synths, then I will explain how to load them into the synths.

Obviously the first thing you need to do is to download and install Scala on your computer, you can find the direct link below:

http://www.huygens-fokker.org/scala/downloads.html

Read installation instructions on downloads page, for mac read this: http://curtismacdonald.com/microtuning-midi/

On Windows you must also install gtk2-runtime-2.24.10-2012-10-10-ash.exe for Scala to work, it is available for free here: http://gtk-win.sourceforge.net/home/index.php/Main/Downloads

Then to get the Pythagorean and Ptolemy scale pre-sets that I used in this book into Scala you need to download the free zip file with 1000's of scales from this link: http://www.huygens-fokker.org/scala/downloads.html

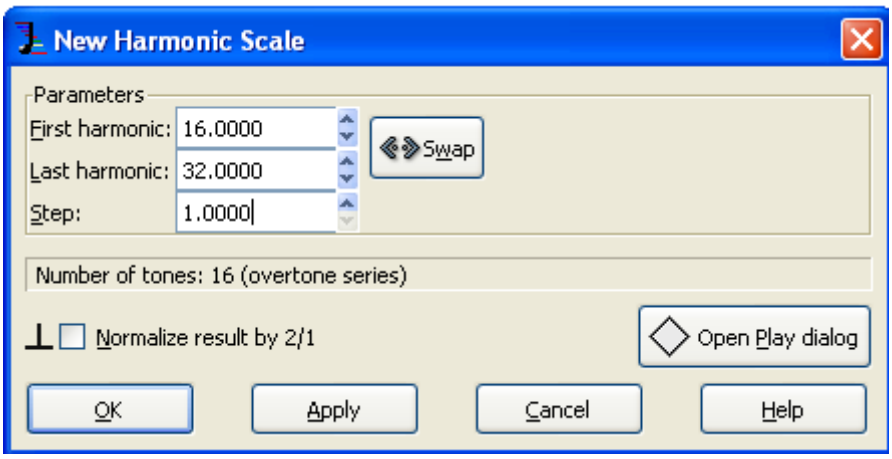
Unzip this zip file into the folder in your program files where you installed Scala.

The scales in the zip file are in the ".scl." format, they cannot be loaded into synths but they can be opened edited in Scala and then exported in a variety of formats for various software and hardware synths.

A good way to start is by loading any 12 tone scale and then to edit it to the frequencies that you want, this is easier than generating it from ratios. There are two easy way to do this: by loading any 12 tone scale from the scales zip file or if you don't have the zip file, by generating any 12 tone scale in the scale generator and editing the notes manually.

If you want to generate a scale, just go to "file", "new" and "scale". There you will find some nice options to generate your own .scl files which you can then edit and convert to .tun or another format. If you select “12 tone equal temperament", then you will get exactly that, a good scale to start with if you want to edit it to another 12 tone scale.

You could also select "harmonic scale" and you will get a very nice 12 tone harmonic scale made from the 4th to 16th harmonics, you can change it to 16 to 32 for the factor 9 scale or any other settings that you like.



To use this 16 tone scale on a 12 tone keyboard you can also edit it manually, choosing the 12 best sounding tones to make your own custom scale that best suits the music you are making. To edit the frequencies of the individual notes in a scale manually using charts from my book, just go to 'edit' and 'edit scale' then you can double click on any frequency and enter a new one. If you want to hear the scale before exporting you can just click 'play' on the bottom right, then when you click on a frequency in the chart it will play that note in the built in midi player. Don't forget to hit 'apply' and 'OK' afterwards.

You may have noticed that you are only editing one octave. This is because "Scala" automatically generates the other octaves for you, so once you have edited all the notes to the correct frequencies you can move to the next step.

If you want to load a .scl file from the zip file instead of generating one you will find that the magic scales are already there. Below are their names as they are in the zip folder:

pyth_12.scl (12 tone Pythagorean scale)

ji_12.scl (12 tone Ptolemy / chakra scale)

ptolemy.scl (7 tone Ptolemy / chakra scale)

Once loaded into scala these pre-set scales or your generated / edited scales are almost ready to export and use in a synth. The only problem is that they all have a reference pitch of 440 Hz, the same as all the pre-set tuning files that came with your vst's do. You may want to change this to 432 Hz, 192 Hz or another magic frequency.

To do this, just follow the steps below:

1 Start "Scala" and click 'open'.

2 Browse to find your file (pyth_12.scl etc.)

3 Load your .scl file into Scala (or generate a scale as explained above).

4 Type 'show scale' in the command box at the bottom and hit 'enter' to see some scale details.

Type 'show map' and hit enter to see some more.

As you can see the scale automatically analyses your scale telling you the ratios and the notes. You can also go to 'view' and 'show scale by frequencies' to get a full Hz readout. To see what your scale will look like with different reference pitches click 'freq' (marked with a tuning fork) and there you can try different ones by hitting 'show scale by frequencies' again.

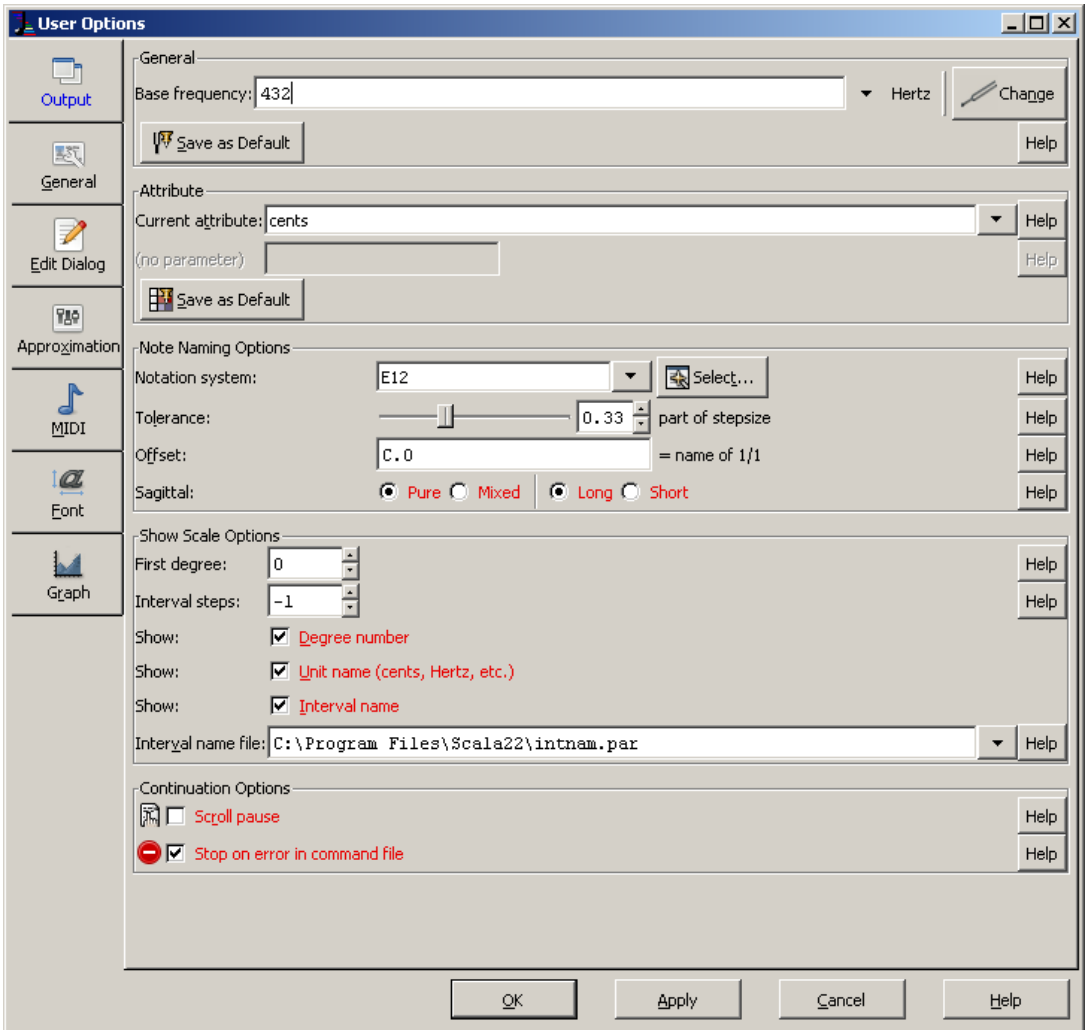
So now that you have your scale loaded / generated, all you need to do is three things:

1. Specify the reference pitch (note around which all the others will be built using the scales ratios).

2. Set this reference pitch to a midi note on your keyboard (A4 or G4 etc).

3. Set mapping if you have more or less than 12 tones in your scale.

The place to do all of this is in 'edit' then 'preferences'. This will open “user options”.



Make sure you are in the output section (check top left box), As you can see right on top, I have changed the base frequency to 432 Hz for the Pythagorean scale, for the chakra scale you need to set this to 192 Hz. It also has 256 Hz as a pre-set option which is also a good root for many scales.

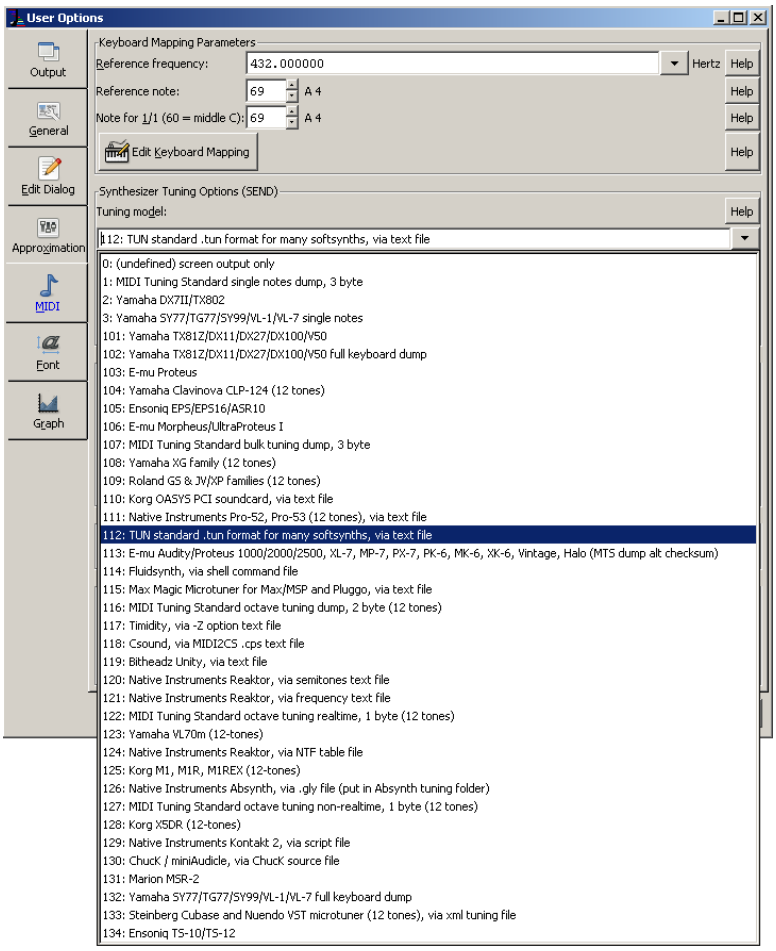
Some synthesizers refuse to play the base frequency, playing all the notes perfectly except for 432 Hz, 256 Hz or 192 Hz itself. To solve this problem I set my base frequency to an octave that is just below hearing range so for 432 Hz I would use 27 Hz and for 192 Hz I would use 24 Hz.

Next, go to the next window 'general' (below output on top left). There in 'file option' you can set where your finished .tun (or other format) tuning file will get exported to.

Now in the tabs on the top left, go to the 'midi' window. Right on top you can set your 'reference frequency to 432 Hz. Then just below that you must change 'reference note' to 'A4' if you want 432 Hz to be 'A' on your keyboard. Below that, change 'note for 1/1' to 'A4' as well. If your reference frequency is C = 256 Hz then you should choose 'C4'' instead, if it is G = 192 Hz choose 'G4' and so on.

For synthesizers that will not play the base frequency I set this to be a very low note that I never actually play, for ‘A’ I use ‘A0’ or ‘A1’ for ‘G’ use ‘G0’ or ‘G1’ etc.

Then, very importantly, you must choose the format for your exported file. The .tun (112) format is for VST synths, but there are many formats for hardware and other software synths and applications under “synthesizer tuning options”.


User Options
Output
General
Edit Dialog
Approximation
MIDI
Font
Graph
Keyboard Mapping Parameters
Reference frequency:
432.000000
Hertz
Help
Reference note:
69
A 4
Note for 1/1 (60 = middle C):
69
A 4
Edit Keyboard Mapping
Synthesizer Tuning Options (SEND)
Tuning model:
112: TUN standard .tun format for many softsynths, via text file
0: (undefined) screen output only
1: MIDI Tuning Standard single notes dump, 3 byte
2: Yamaha DX7II/TX802
3: Yamaha SY77/TG77/SY99/VL-1/VL-7 single notes
101: Yamaha TX81Z/DX11/DX27/DX100/V50
102: Yamaha TX81Z/DX11/DX27/DX100/V50 full keyboard dump
103: E-mu Proteus
104: Yamaha Clavinova CLP-124 (12 tones)
105: Ensoniq EPS/EPS16/ASR10
106: E-mu Morpheus/UltraProteus I
107: MIDI Tuning Standard bulk tuning dump, 3 byte
108: Yamaha XG family (12 tones)
109: Roland GS & JV/XP families (12 tones)
110: Korg OASYS PCI soundcard, via text file
111: Native Instruments Pro-52, Pro-53 (12 tones), via text file
112: TUN standard .tun format for many softsynths, via text file
113: E-mu Audity/Proteus 1000/2000/2500, XL-7, MP-7, PX-7, PK-6, MK-6, XK-6, Vintage, Halo (MTS dump alt checksum)
114: Fluidsynth, via shell command file
115: Max Magic Microtuner for Max/MSP and Pluggo, via text file
116: MIDI Tuning Standard octave tuning dump, 2 byte (12 tones)
117: Timidity, via -Z option text file
118: Csound, via MIDI2CS .cps text file
119: Bitheadz Unity, via text file
120: Native Instruments Reaktor, via semitones text file
121: Native Instruments Reaktor, via frequency text file
122: MIDI Tuning Standard octave tuning realtime, 1 byte (12 tones)
123: Yamaha VL70m (12-tones)
124: Native Instruments Reaktor, via NTF table file
125: Korg M1, M1R, M1REX (12-tones)
126: Native Instruments Absynth, via .gly file (put in Absynth tuning folder)
127: MIDI Tuning Standard octave tuning non-realtime, 1 byte (12 tones)
128: Korg X5DR (12-tones)
129: Native Instruments Kontakt 2, via script file
130: ChucK / miniAudicle, via ChucK source file
131: Marion MSR-2
132: Yamaha SY77/TG77/SY99/VL-1/VL-7 full keyboard dump
133: Steinberg Cubase and Nuendo VST microtuner (12 tones), via xml tuning file
134: Ensoniq TS-10/TS-12

Before you close the 'user options' window remember to hit "apply" and "OK" at the bottom of the screen to apply your settings to the scale.

If you have a 7 tone scale or another odd number of notes that you want to fit into one octave, you can set it to all your white notes or other mappings. Just go to 'open mapping', select a mapping and click 'OK'.

Now all you need to do is go to 'file' and 'export synth tuning'.

Under 'file name' just enter your file name then click 'OK'. Now your .tun (or other format) file is exported and ready to load into your synth! You can find your file in the folder that you specified in 'user options'.

If you use Logic or a vst that uses .scl files then just use “file” and “save scale” on the top of the program instead of file export.

IMPORTANT: Many people, including me have been having problems with .tun files making synths do some crazy things, mostly in Omnisphere ®.

I have solved this problem in Omnisphere ® by opening one of the preset .tun files that come Omnisphere ® using Wordpad and then comparing it to one of my own, also in Wordpad. When I looked at the code, I found lots of stuff in my one that was not in the preset one. This is not hard to do, all the junk code was at the bottom (end) of the file, (the whole “anamark” and “functional tuning” section) so I just deleted the whole second half and saved the new version (all in Wordpad) leaving only the top part and the end part that looks like this:

```
; Set reference key to absolute frequency (not scale note but midi key)
note 24="! 24.000000"
[Scale End]
```

Don’t forget to save before closing WordPad!

These edited files now work in Omnisphere and all my other vst's. If however you are having problems with a certain vst I would recommend taking a look at some of its preset tuning files in wordpad and comparing them to your own.

You need to be very patient when starting to use .tun files, your synthesizers may do strange things or even refuse to work at all with the files. I still sometimes spend weeks getting a new vst to work, once everything is up and running though then you can just make music as always. Once all of your scales are loaded and ready to select as presets in your synth menus it is very quick to change tunings.

If you need help with this post a question in my FB group **Life, the Universe and 432 Hz**

How to load tuning files

(Software synths)

By now you must really want to know how to load these tuning files into actual synths. I will start with software instruments and then move to hardware.

First make a folder somewhere on your PC called ".tun files" to keep the .tun files in, remember where they are so you can browse and easily find them again from your various VST's scale browsers. Each VST is a bit different so I will write instructions for all the ones I have used successfully.

ALBINO®

Just click on the word 'Albino' on the bottom right of the synth to see the back of the synth, now at the bottom right above the fake stereo out plugs is a box. Click the load

button and browse for the .tun file that you want, Albino comes with some preset .tun files. They will be in your Albino program files (where you installed Albino).

CRONOX®

Cronox is the same as Albino, just click on the word 'Cronox' to see the back of the synth or click setting on the top right, it does the same thing. Now browse for your .tun files and load as with Albino, very simple. This synth is also the only stable micro-tunable sampler that I have found so it is very good to have for playing your own sounds with a micro-tuned scale.

OMNISPHERE®

For Omnisphere you have to copy and paste the .tun files into the Omnisphere program files. Just go to:

program files - spectrasonics - steam - omnisphere - settings library - presets - tuning file

Make a new folder in this tuning file folder and call it "my tuning files" or something, now just paste your new .tun files into this folder.

Then to load it into the synth just open Omnisphere and look in the middle of the main front window a bit to the left. You should see a box called "scale" you will now find your new folder and files there, remember this synth is tricky with tuning files but when you make one that works you can use it forever, so it is worth the effort.

ALCHEMY®

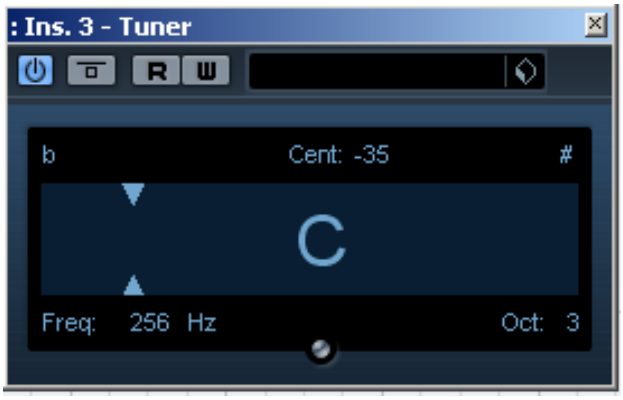
As with Omnisphere, go to:

program files -- camel audio -- alchemy --- Libraries -- Tuning

Paste your files there then to load look at the top right of the main window of the synth. There is a box called "Tuning" in which you will find your .tun files.

GOOD TIP: Set up a VST synth to play a clean saw tooth wave then use the 'tuner' plugin in Steinberg Cubase® or a similar Hz based guitar tuner to check that you really have the right frequencies mapped to the correct notes. This is important because as I said bugs and errors can occur with home made .tun files.

It is also good to analyze the preset scales that come with your synths, some are very good and can be used in other synths too. With master tune on your synth it is also very easy to make a 440 Hz Pythagorean scale into a 432 Hz one.



These are not the only VSTs that can load .tun files, there are many more (full list later on this page) and most of them will work in one of the two ways described above.

How to load tuning files

(Hardware synths)

For hardware synths you start by exporting your scale from Scala in the correct format for that synth. Only some hardware synths can be micro tuned like this and you will definitely need your synths' operation manual to find out the specifics for each synth, like the strange key combinations sometimes needed to activate midi dumps. Some modern synths also have a flash card slot that can load tuning files, usually using a specific format and loading method for that synth.

Many hardware synths use some form of bulk dump midi files. Scala can make quite a few types of these midi files, so if you have the right synth and want to load one of these files into it, all you need to do is follow these steps.

Loading midi dump files:

1. Load your midi dump file on a midi track in your music workstation (Cubase® **Logic®** etc) or hardware sequencer.

2. Connect the 'MIDI Out' of your workstation to the 'MIDI In' of your hardware synth.

3. Solo the Track with the midi file and make sure your synth and computer are set to the same midi channel (Channel 1 is best as it is often the default setting).

4. Make sure your hardware synth is set up to receive a bulk midi dump (This info you will find in your synths user manual).

5. Play back the data into your synth by hitting the play button in your workstation. Wait until it is played through and this should do it. Your synth "will" now be re-tuned.

Here is the full list of hardware and software synths that are compatible with Scala.

(List from the Scala website.)

Alphakanal Automat
AnaMark softsynth
Big Tick Angelina, Rainbow and Rhino softsynths
Bitheadz Unity softsynth
Cakewalk Dimension Pro
Cakewalk Rapture
Cakewalk Z3ta+ softsynth
Camel Audio Alchemy and Cameleon5000 softsynths
Celemony Melodyne 2
ChucK
crusherX-Mac!
DashSignature EVE one (not two)
Devine Machine OTR88
E-mu Morpheus
E-mu Proteus series
Ensoniq EPS/EPS16/ASR10
Ensoniq TS-10/TS-12
Fluidsynth (iiwusynth) software synthesizer
HERCs series, Abakos Pro softsynths
Image-Line Harmor
Kemper Digital Virus
Korg M1, M1R octave tuning dump
Korg X5DR octave tuning dump
Korg OASYS PCI soundcard (and softsynths supporting its .tun tuning textfile)
LinPlug Albino 2, Alpha 2, CronoX, Octopus, Organ 3 and Sophistry softsynths
Manytone ManyStation, ManyGuitar, ManyOne softsynths
Marion MSR-2
Max Magic Microtuner for Max/MSP and Pluggo softsynths
MIDI Tuning Standard (both bulk tuning dump and single-note tuning change, 3 byte), supported in Timidity and Audio Compositor, E-mu: Proteus 3, UltraProteus, Audity/Proteus 1000 and 2000 series, Virtuoso 2000, Proteus FX, Orbit, Planet Phatt, B3, Carnaval, Ensoniq: ASR-X, MR Rack, MR-61, MR-76, ZR-76, Turtle Beach: Multisound, Monterey, Maui, Tropez, Rio
MIDI Tuning Standard 2-byte octave tuning dump
MIDI Tuning Standard 1-byte octave tuning dump
MIDI to CSound
Modartt Pianoteq 4
Mutagene Mukoco, Macomate 88
Omringen Oblivion
Native Instruments Absynth 2 (via .gly file)
Native Instruments FM7 and Pro-52/Pro-53
Native Instruments Kontakt 2 (via script file)
Native Instruments Reaktor (via semitones file, frequency file or NTF file)
Pure Data
Robin Schmidt's Straightliner softsynth

Roland GS & JV/XP families
Roland Fantom-X6/X7/X8
Roland V-Synth Version 2.0
Roland Virtual Sound Canvas, SC-8850
Smart Electronix Foorius
Spectrasonics Omnisphere softsynth
Synapse Audio Orion Pro softsynth
Synthesis Technology MOTM-650
Synthogy Ivory
Timidity and Audio Compositor MIDI to audio renderers
Tobybear Helios softsynth
VAZ Plus, 2001 and Modular softsynths VirSyn Cube, Cantor, Poseidon and TERA 2 softsynths
Xponaut Voice Tweaker
Yamaha DX7II/TX802
Yamaha SY77/TG77/SY99/VL-1/VL-7
Yamaha TX81Z/DX11/DX27/DX100/V50 (both octave and full keyboard bulk data)
Yamaha XG family
Yamaha VL70m
WayOutWare TimewARP 2600
Wusik Wusikstation v2
Xenharmonic FMTS VSTi
Zebra 2.0 softsynth

Some synthesizers allow you to adjust each note using a slider and the value “cents”

With the sliders set to 0 you will have an equal temperament scale with exactly 100 cents in each semi-tone, to calculate the amount of cents needed to play the Pythagorean, Ptolemy or any other scale just open it in Scala and type “show scale”.

You will see your ratios are also displayed as cents in the right column (see next image)

```
12-tone Pythagorean scale
|
  0:          1/1              0.000000 unison, perfect prime
  1:       2187/2048         113.685006 apotome
  2:          9/8            203.910002 major whole tone
  3:         32/27           294.134997 Pythagorean minor third
  4:         81/64           407.820003 Pythagorean major third
  5:          4/3            498.044999 perfect fourth
  6:        729/512          611.730005 Pythagorean tritone
  7:          3/2            701.955001 perfect fifth
  8:       6561/4096         815.640007 Pythagorean augmented fifth
  9:         27/16           905.865003 Pythagorean major sixth
 10:         16/9            996.089998 Pythagorean minor seventh
 11:        243/128         1109.775004 Pythagorean major seventh
 12:          2/1           1200.000000 octave
```

Compare your scale to the equal temperament scale (next image).

```
  0:          1/1              0.000000 unison, perfect prime
  1:       100.000 cents     100.000000
  2:       200.000 cents     200.000000
  3:       300.000 cents     300.000000
  4:       400.000 cents     400.000000
  5:       500.000 cents     500.000000
  6:       600.000 cents     600.000000
  7:       700.000 cents     700.000000
  8:       800.000 cents     800.000000
  9:       900.000 cents     900.000000
 10:      1000.000 cents    1000.000000
 11:      1100.000 cents    1100.000000
 12:          2/1           1200.000000 octave
```

Now all you need to do is to look at each note to see if it is higher or lower than the same note in equal temperament, if it is higher you need to raise the cents value and if it is lower then you need to lower it. Remember this + or – value for each note because it makes the actual calculation much easier.

To complete the calculation, just compare each note to its equal temperament counterpart and subtract the smaller of the two from the larger. The answer that you get will be the amount of cents needed to detune that note from equal temperament to your new scale. Remember to check if the new note is higher or lower than it is in equal temperament so that you know whether to raise or lower the slider on you micro tuner.

You will find that cents are not a magical as Hz when it comes to harmonic frequencies and that your numbers will always have too many decimals for your micro tuner. It is not too bad however because one cent = about a quarter of one Hz so you will never be off by more the ¼ of one Hz if you ignore all of the numbers after the comma in cents.

If your synth hardware or software cannot be tuned at all and is fixed to the equal temperament scale, you do still have some options as most can have their master pitch adjusted. If you are working with an equal temperament fixed scale synth, the best thing you can do is to look for a master tune setting or knob / slider to see if you can dial in 432 Hz instead of 440 Hz.

If your master tune works with knob or slider that works in Hz, then lowering it by 8 Hz will bring your A = 440 Hz to A = 432 Hz. If your tuning adjuster works in "cents" then just lower it by 32 cents. Some synths seem to behave differently to others, so the only way to know for sure with all of these methods is to use a tuner plug-in to check it for yourself. If in the worst case there is no master tune, then look for fine tuning adjustments in the synth oscillator settings and just tune your oscillators to the right frequency there.

Tuning Acoustic Instruments

If you are tuning an actual instrument like a harp, then your best bet will be to look at the charts in this book or generate frequency charts yourself in Scala. Then you could use a hardware or software Hz reading tuner and a microphone to tune your instrument. Another very good way is to use a VST synth with your scale loaded and with a pure sine or saw wave preset, and to tune the actual instrument to match the notes to ear.

It is also good to know that there are many Pythagorean 432 Hz, 256 Hz, 192 Hz and 288 Hz tuning forks available online, these are great for tuning instruments.

If you are tuning a guitar or other instrument that can only be in equal temperament, just tune your A to 432 Hz and then tune the rest of the notes around that in the normal way. That will place your frequencies for C, G, D and A within 1 Hz of our 4 magic numbers C = 256 Hz, G = 192 Hz, D = 288 Hz and A = 432Hz, and the rest very close to where they are in the matrix of amazing numbers.

A word for DJs

If you want to use software to pitch shift a whole track to 432 Hz remember to use a setting that slows the tempo down too like an analogue tape or record would. Software that tries to keep the tempo the same while changing the pitch will make a mess of the frequencies and your music, the bass in particular will sound bad on a big party rig. I use sonic foundry® Soundforge® for this because It has a very good pitch shift function under "effects". Make sure the “preserve duration” box is unchecked, then it will slow the tracks tempo down too, keeping the quality of your sound good without messing up the waveforms and harmonic intervals with needless conversions.

Brainwave Entrainment Techniques

If you are working in a music workstation and need harmonic BPMs to go with your brainwaves, then the next two charts are the place to look. The big chart at the bottom of the page has the same frequencies as the Ptolemy chakra scale, but they are re-arranged starting with C instead of G for easier color coding.

All you need to do is choose note on the left, or a BPM on the far right and in-between on the same horizontal row you will find all the harmonic brainwave frequencies in Hz. It is color matched to the smaller chart on top of the page so all green frequencies are theta, all yellow are delta and so on.

Brainwave States	Range of each State	Properties
High gamma	64 Hz – 128 Hz	Unity / spiritual insight
Gamma	32Hz - 64 Hz	Very alert
Beta	16Hz-32Hz	Alert, normal waking state
Alpha	8Hz-16Hz	Relaxed
Theta	4Hz-8Hz	Psychedelic / meditation
Delta	2Hz-4Hz	Deep meditation
Low delta	1Hz to 2 Hz	Unconscious / deep sleep
Epsilon	0 Hz to 1 Hz	Out of body / spiritual insight

Note	Audio and Brainwave Frequencies in Hz											BPM's
B	120	60	30	15	7.5	3.75						56.25 112.5
A#	115.2	57.6	28.8	14.4	7.2	3.6	1.8	0.9	0.45			54 108
A	108	54	27	13.5	6.75	3.375						50.625 101.25
G#	102.4	51.2	25.6	12.8	6.4	3.2	1.6	0.8	0.4	0.2	0.1	96 192
G	96	48	24	12	6	3	1.5	0.75				90 180
F#	90	45	22.5	11.25								84.375 168.75
F	86.4	43.2	21.6	10.8	5.4	2.7	1.35					81 162
E	80	40	20	10	5	2.5	1.25					75 150
D#	76.8	38.4	19.2	9.6	4.8	2.4	1.2	0.6	0.3	0.15		72 144
D	72	36	18	9	4.5	2.25						67.5 135
C#	67.2	33.6	16.8	8.4	4.2	2.1	1.05					63 126
C	64	32	16	8	4	2	1	0.5	0.25			60 120

Binaural beats

Binaural beats are most often made using software, although you can use acoustic instruments too. In ancient times people used two de-tuned singing bowls, didgeridoos or other drone producing instruments. Nowadays however there is some very nice software available for creating binaural beats, as usual the most useful software is freeware / shareware that not many people know about, like "Valhalla echo®". If you want to make binaural beats using your music workstation then this simple little secret plugin is the gem of gems.

Valhalla echo®

"Valhalla echo®" can be downloaded for free here in a zip file: http://www.valhalladsp.com/valhallafreqecho To install simply unzip the file to the directory where you normally install your VST plugins.

This is a very simple and yet the most useful tool for binaural beats that I have found. It can run in most music workstations, on Mac and PC.

While it is really meant for making crazy sounds, it can also be used to de-tune left /right channels to specific Hz and so can be used to de-tune any sounds making them into binaural beats. This is very useful because pure computer-generated sine waves can be rather harsh, with this plugin however you can use a warm analogue synth sine wave or any sound in your music that you want to be your carrier signal.

When all the knobs are set up just like it is in this image (make sure 'delay sync' is set to "free") then the big middle knob becomes a stereo Hz de-tuner, embedding perfect binaural beats into whatever audio is passed through it. This is very useful because it is a VST and so can be used in real time on any sound in your song.

If you set up an FX send channel with a reverb and Valhalla, then you can send this to many channels creating a nice ambient / binaural wash in the background through your whole track. (A group track can be set up in a similar way).

If you use harmonic BPM then this is a powerful tool, just divide your BPM by 60 and use octaves of that frequency to dial into Valhalla. The slider is too sensitive for exact Hz work but you can click on the numbers under the dial (Hz) and enter any frequency with your PC keyboard. Or if you right click on the numbers you can use 'copy and paste' to paste numbers from your calculator or from any text file, this is very handy.

You should note that if set to 4 Hz, it actually raises the right channel by 4 Hz and also lowers the left by 4 Hz. So with a setting of 4 Hz the end binaural beat will be 8 Hz and not 4 Hz. The fact that it raises and lowers each channel is good since this makes it more musically useful. If it only lowered one channel while keeping the other the same then the resulting sound would be a bit "flat", whereas if it only raised one channel then the resulting sound would be a bit sharp.

This is generally the best tool that I have found for adding binaural beats into music.

BWGEN®

Brainwave generator or BWGEN is another amazing piece of software downloadable for free here: http://www.bwgen.com/download.htm

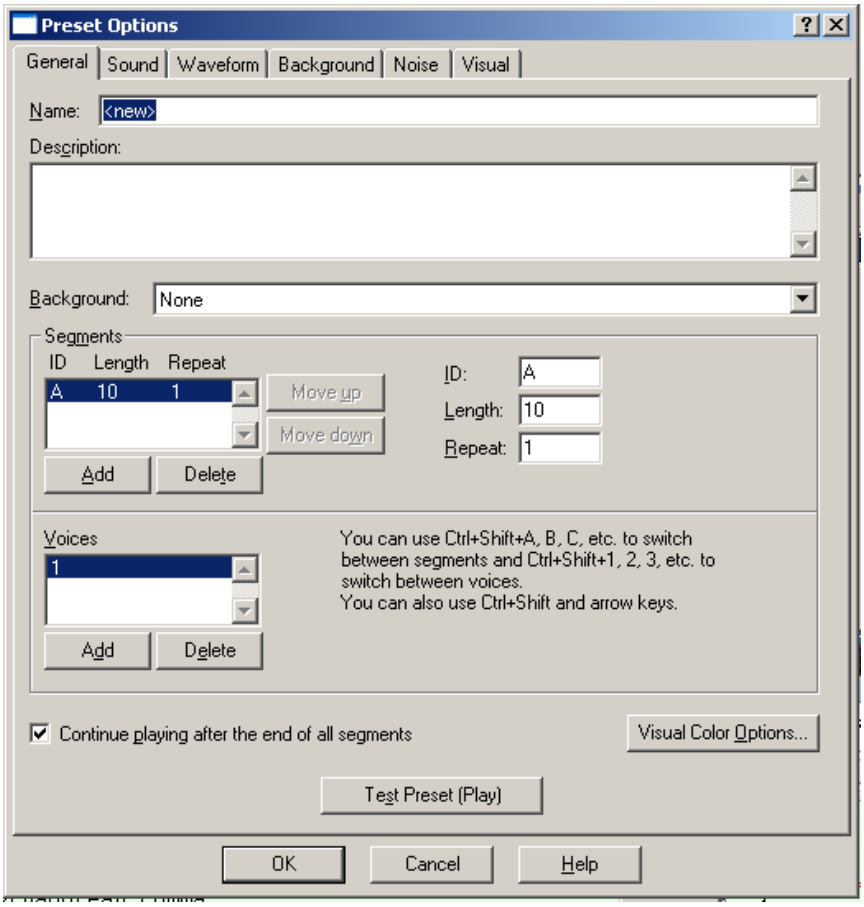
It is a stand-alone (not a plugin) but it does have an 'export to wave file' option. With BWGEN you can easily make the classic sine wave based binaural beats that you see on YouTube or buy online as products like "E dose". It can produce triangle, square and other useful wave forms too. You can also have more than one wave / binaural beat at the same time creating complex brain states.

It is easy to make programs where the different tones or beats clash with each other sounding disturbing and giving you a headache. Such programs feel "powerful" but not in a good way, that is why you should use the chapters in this book on harmony if you want more than one binaural tone at the same time, then you will see that you should use octaves, pure fifths, pure major thirds or other harmonic intervals to separate your audible tones and binaural beat frequencies so that the overall sound will be good and soothing instead of out-of-tune and disturbing.

BWGEN comes with some nice presets that you can use or edit as a starting point, you can easily make your own too.

Here is a quick lesson:

Go to 'wave' and then 'preset options' and 'general'. You will see this:



Here you can name your program, set its length in minutes and add segments and voices. Segments are for more complex changes in your program while voices are for adding more than one voice or tone at the same time.

Now go to 'sound' next to 'general', here can set your binaural beat frequency and your audible pitch frequency. If you have more than one voice you need to go back to 'general' and 'voices' and select each voice to edit them there.

Your tones can easily be set to sweep from one frequency to another, just click on the small square white "nodes" to open the 'sweep parameters' box. The default setting for the audible pitch is to track the binaural beat frequency; that generates an audible pitch that is in mathematical harmony with the binaural beat frequency. This is helpful if your binaural beat frequency is slowly changing over time and you still want a harmonious tone for a carrier that changes in harmony with moving beat frequency.

If you want to set your own frequency uncheck this 'track' box and use the small square white "nodes" to open the 'sweep parameters' box. Then you can set a stable or sweeping frequency for your carrier voice, with a stable Hz frequency for the carrier tone you can make sounds that are in tune with your music's' root frequencies.

The next preset option next to "sound" is "waveform", here you can choose different waveforms for each voice which is quite nice, with the square and triangle waves you can also make some crazy short binaural sound effects. In the other two boxes, 'background' and 'noise' you can set up a few background sounds to mix with the beats such as nature sounds, white / pink noise etc. I would really recommend adding sounds in a better audio workstation though, to do this just export your binaural beats to wave under 'wave' and 'play into .WAV file', then load them into your workstation.

Cool edit pro®

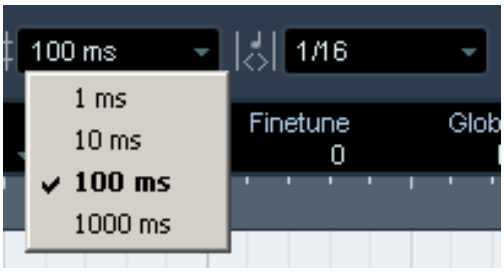
Adobe® Cool edit pro also has a nice brainwave synchronizer under "effects" and "special" called "brainwave synchronizer". This is a nice and very simple plugin that can apply binaural de-tuning to any audio in a similar way to Valhalla echo. It can't be used live in a workstation though, you have to apply it to audio and export into wave file for later use.

Isochronic tones

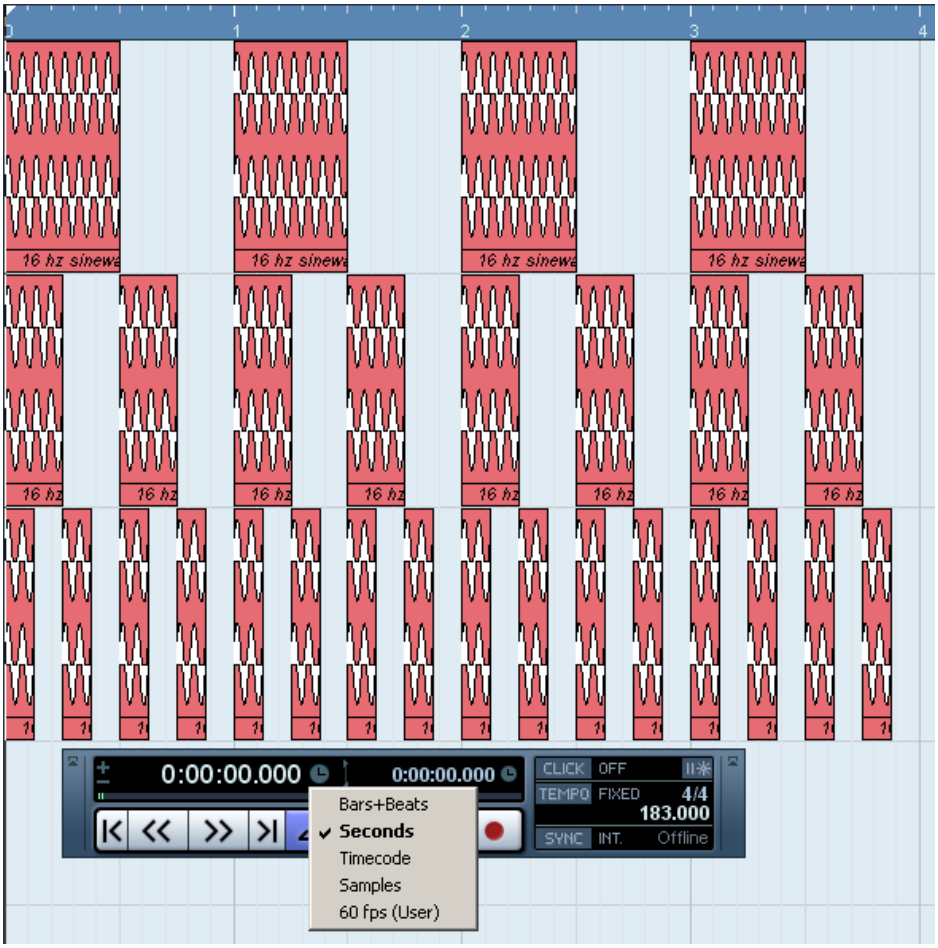
As I mentioned before, isochronic tones use the same frequency charts as binaural beats. You can look at the start of this chapter for a full list of useful frequencies that will work best for this, (software decimal limit wise)

When you work with isochronic tones the border between brainwave work and music becomes really thin. One known way of working with isochronic tones is to apply a randomizer to the carrier tones frequency and / or panning so that each successive tone is a different random frequency or in a different ear. Music producers do this all the time, it is just one step away from being a panned melody or arpeggiated synth line, very much like the African tribes who use those stereo interlocking "binaural" melodies to induce trance by placing an mbira player at each ear of the trancer.

A pure scientific isochronic tone is very carefully shaped and tuned sound. The best way to make pure isochronic tones is in your PC music workstation, for example in Cubase® or Logic®. If you want to make pure "scientific" tones with no music a very interesting option is to set your quantize to seconds instead of beats and bars, when you do this it disables your normal quantize and enables the other milliseconds (ms) quantize next to it (in Cubase®). Now you don't need to worry about Hz / BPM conversion.



In the image below you can see how easy it is to make 1 Hz, 2 Hz and 4 Hz (pulses per second) isocronic tones. Look at the 4 seconds marked by your seconds quantize in the blue bar at the top and count how many pulses are in each one second gap.



Interestingly enough, if you change the BPM with this setting (in Cubase®) everything shifts (my BPM is 183 BPM here) but as long as you put your sounds back on their places in the blue ms grid on top, the actual end tempo will always be the same to the ear. (Basically you can ignore your BPM setting and just look at the seconds in the top blue bar). I have tried to make normal music like this (using only seconds and milliseconds), but it is quite tricky. Using BPM and normal quantize is more familiar.

In the previous chapters on entrainment and harmonic BPM I explained how to set your project with a BPM that matches your reference pitch and lower Hz frequencies for your isochronic tones. If you do this you can use your quantize and short Audio slices or a gate plugin on a long audio tone to time your pulses so that they match the Hz frequencies in the charts exactly.

If you change your grid from 'bars and beats' to 'seconds', the audio will still sound the same but the blue bar will now show the time in seconds. This is very useful to quickly check how many pulses there really are in one second while still working with normal BPM quantize settings.

There are two ways to get your actual tones. You can just use a synth with a pure wave form, or you can make the waves in another program and import them to use as pulses. If you render them first, it is good to render them a bit longer than they should be, because then you can then edit out start or end clicks etc to make nice clean shorter pulses, and you can also then line all of the wave shapes up better by always starting on a "zero point" in the center where the wave crosses the line of no air pressure.

Another method is to use long waves with a gate effect to create the isochronic pulse. This also works well, obviously you need to use pure sinewaves for accurate single Hz work, but as I mentioned earlier since all sound modulation is entraining, you can slice or gate any sound and it will still have strong entraining effects. (This is used in a lot of electronic music already).

If you want to use more than just octaves you can also use 5ths, to do this just use the triplet settings in your quantize, in this way you will create triplet isochronic tones. For more detailed info and frequency charts refer to the earlier chapters on entrainment and harmonic bpm's.

If you tune your music to its harmonic BPM then your music will automatically be quite isochronic. All you really need to do is study this chart and keep in mind what kind of rhythms create which kind of brainwave knowing that the rules are the same for any BPM between 120 and 240 BPM.

Quantize settings + Sound examples			
Brainwave State	Sound Example	QUANTIZE SETTING For audio pulses and effects	All Tempos 120 to 240 BPM
Epsilon	Quarter time	1/1	120 to 240
Low Delta	Halftime	1/2	120 to 240
Delta	Trance / house Kickdrum	1/4	120 to 240
Theta.	Double time, oompah kick / bass	1/8	120 to 240
alpha	Kbbb bass / shaker / tambo groove	1/16	120 to 240
beta	drumroll	1/32	120 to 240
gamma	Low Tone	1/64	120 to 240
Audio tone	Audio tone	1/128	120 to 240
Audio tone	Higher Audio tone	1/256	120 to 240

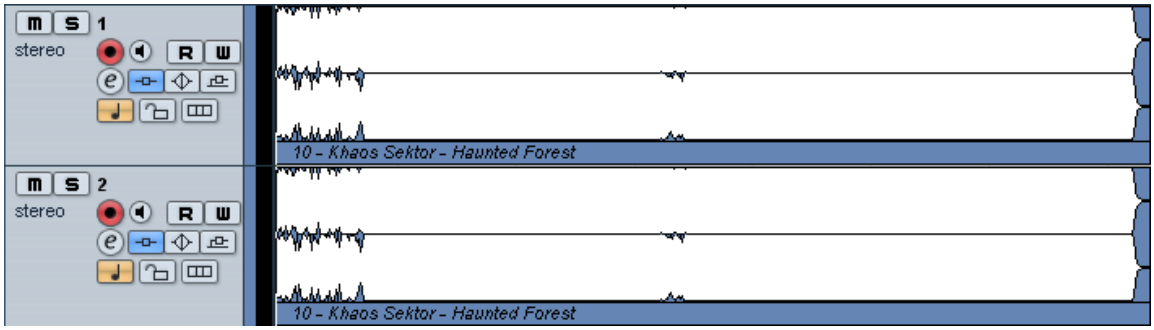
Embedding brainwave frequencies into pre-made music

You may have seen classical music or other audio works that claim to have binaural beats or isochoronic tones "embedded" into the audio. It sounds complex but is actually very simple. All you need to do is to split your audio into frequency bands using equalizers or filters, and then apply binaural de-tuning or isochronic gating to one or more of these bands, choosing bands that don't mess up the overall sound too much.

A common method for embedding binaural beats into classical music is to isolate the low sub bass and to apply de-tuning there, in this way the music will still sound good. If you de-tune the higher frequencies in classical music you will find that your music may sounds as if it is playing through an effect like a tremolo or chorus. This is not good if you want the binaural beats to be "hidden".

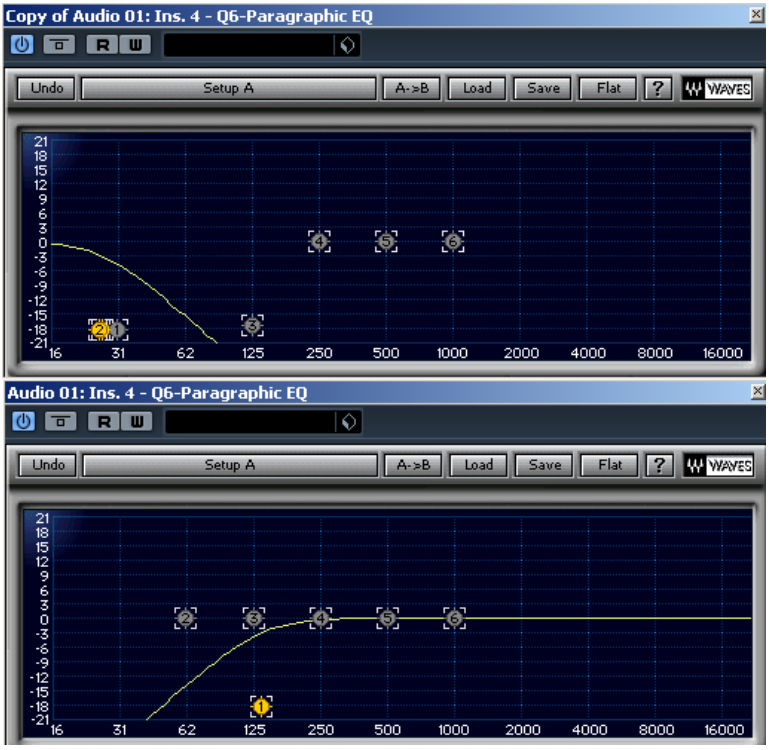
The best software to use is your normal music workstation such as Cubase or Logic. You do get special software for de-tuning audio and embedding beats, but they are all very limited and will never be as good as a workstation with all its equalizers and filters.

To separate the sub bass from some music so you can de-tune it without affecting the higher parts is easy. All you do it duplicate your song channel, so you have two channels with same thing playing:



Then apply different equalizers to each channel so one channel will play only bass, while the other plays only mid-range and high frequencies.

In the image below I used waves® Q6 equalizer.

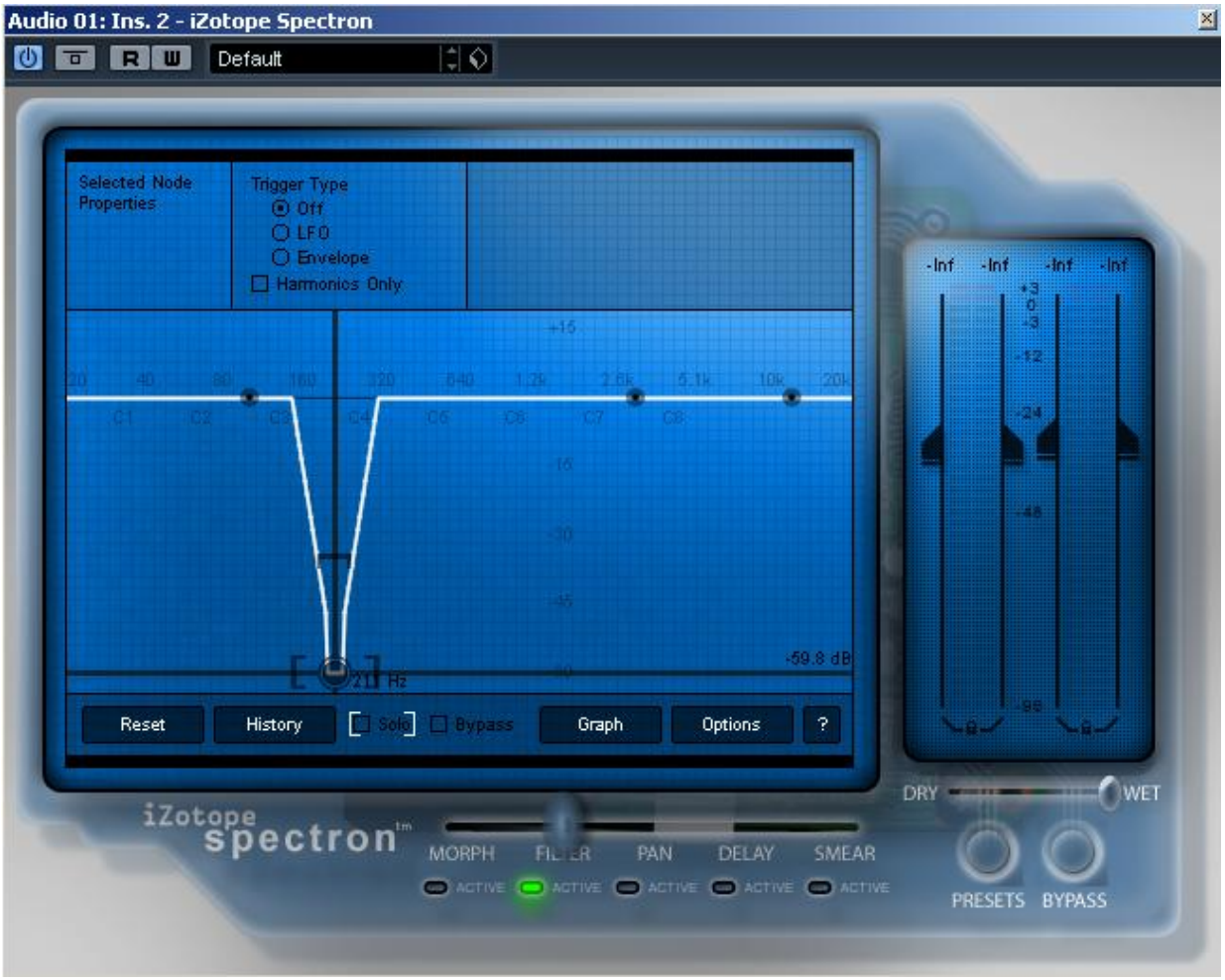


Now all you need to do is to apply isochronic gating or binaural detuning to the channel that is playing only bass.

All workstations have gate plugins with which you can also pulse one of the bands isochronicly, making embedded isochronic tones. Obviously if you want to embed binaural beats just use Valhalla delay on only the bass track. Of course you can use other frequency ranges in narrow bands, not only sub bass and not only 2 frequencies. For more frequencies just open another channel and use another eq to isolate another frequency band.

iZotope Spectron ®

There is a very nice plugin for separating frequencies into narrow bands in this way. It is called "iZotope Spectron ®". With this plugin you can solo or bypass any frequency band (See small square solo / bypass check boxes in image below). If you solo a band as I have in the image below, then it will play only that band. And if you bypass that band it will play everything but that band.



This means all you need to do is to put an identically set up Spectron on each of your 2 channels that are both playing the same song, and set one Spectron to solo and the other one to bypass. Now when you play both channels together your song will sound whole again, you can then apply some Valhalla delay (binaural detune), some isochronic gating or other tempo synch effects to the channel with the soloed Spectron.

In this way your binaural beats will only be applied to a narrow band of frequencies in the song, leaving the rest of the song unaffected. You also don't have to only use 2 bands, you could cut out more frequencies on the channel set to "bypass". Then you just need to add another audio channel playing the whole song with another Spectron soloing that same frequency.

In this way you could embed 4 different binaural frequencies into the same song, or you could have combinations of isochronic pulses and binaural beats on different bands. If you study the picture above you can quickly set up the same plugin in exactly the same way without reading the very long manual.

Just remember that if you want it to sound really good and to be healthy, that you should find out the tempo (BPM) of the music you are using. Then you can use frequencies and pulses that are lower octaves of your BPM (see the chapter Harmonic BPM). Apart from being more harmonious for your brain and not giving you a headache, if there are some audible pulses or de-tune wobbles they will still sound musically good because they will be in time with the music tempo.

Subliminal audio

Subliminal sounds are sounds that are hidden, either just below or above hearing range, at a very low volume behind louder sounds, or masked in some other way. If you want to make subliminal binaural beats or isochronic tones, a good way is to simply use audio frequencies for your tones that are just above or below our hearing range but still within the range of audio equipment. Very low sub bass isochronic tones have a very nice effect.

You could use the same method of band separation for embedding audio into pre-made music to do this. Or if you are a producer, then you can just add subliminal sound to your music while you are making it.

Subliminal messages

I never use these because the way they work is by by-passing your conscious mind, the part that makes decisions like "this message is bullshit" and goes directly to your subconscious.

I personally have never done this. If you do make audio with subliminal messages remember that you will be the first to be programmed while trying to make it, so generally I would advise against using hidden words or messages, even "positive" ones.

If you really have to do it though, you could use a vocoder with a carrier frequency that is just out of hearing range and your secret message voice as the modulator. Just be careful, taking away a person's and your own choice to think independent thoughts might not be the best thing for you to do even if you think you know what they / you should be thinking.

Subliminal sounds

Examples of less scary subliminal sounds would be to have subliminally soft recordings of forests and other nature sounds hidden in your music, very low isochronic tones or binaural beats to add subsonic subconscious harmony to your sounds and such things.

Some say that your subconscious mind can decode backward sounds, sounds that are sped up or slowed down a lot and even randomized. So the possibilities of subliminal sound are really as big as your imagination.

Primal sound

Primal sound is another healthy side of this kind of thing. Primal sounds are a type of "subliminal" sound where you take a recording of nature, a person's heartbeat or other sound, pitch shift it to a much higher or lower pitch or even use other effects to change them into different sounds. The resulting sounds are always "familiar" and can bring up primal memories; I use these all the time in my music by making small bird sounds into giant dinosaur sounds and things like that.

Good software for pitch shifting is Sound Forge® because of its 'do not preserve duration' option. This also slows the track down as it stretches it out, making it longer but keeping the harmonic intervals etc the same as if you were physically slowing a record or tape down. So this is the best software that I have found to make primal sounds out of things you have recorded. Just make sure to un-check that 'preserve duration' box if you want clean sounds with no noisy digital sound artifacts.

A World of Vibration

It is important to remember that although we have worked out a lot of amazing facts and figures, we have in fact only discovered the natural order of things as they always were. The harmonic series, the golden ratio, and everything in this book are all really just the way of nature.

Birds have been singing the harmonic series for much longer than humans have. So we humans must have learned to make melodies from the birds, the frogs, the crickets and all the rest of the creatures in the first place.

It is a known fact that when left to sing without a reference to tune to, people will always naturally sing in a just intonation / natural type scale and not equal temperament. People who play in orchestras know about this because vocalists and people who play fretless stringed instruments like violins or cellos will also naturally sing or play closer to just intonation. This becomes a problem when you suddenly add an equal temperament tuned instrument like a piano or guitar into the orchestra, when you do this it often takes some time for the other instruments and vocalists to adjust to the unnatural intervals in equal temperament tuning which just are not quite "right".

When our reference pitch was changed from 432 Hz to 440 Hz many vocalists complained that this new higher reference pitch would hurt their vocal chords on some of the highest notes. So this means that vocalists are naturally more likely to sing a scale where A is closer to 432 Hz than to 440 Hz because it is more comfortable for the vocal chords. (This could be because the highest sing able note is now 8Hz lower).

Even in the realm of brainwave frequencies we are really just imitating nature, the best brainwave frequencies are really the sounds of the sea or the sound a stream in a forest full of birds. Running water is much more powerful than any stereo binaural beats or isochronic tones, the sound of moving water is made up of thousands of individual sounds with a very wide range of frequencies and stereo panning. Wind in long grass or reeds will also have a similar effect.

These sounds modulate their amplitude and frequencies in a complex but very comforting and soothing way. I have actually made very relaxing recordings of such things using a stereo microphone on a portable digital recorder. These recordings definitely have powerful and very soothing brainwave effects that always feel healthy and whole, that same feeling you get when sleeping in the sun on the beach or in a forest but obviously not quite as powerful. Such recordings or situations even have the odd bird or other sound to keep you awake, so you don't fall asleep as you can with straight sine wave binaural beats. This is another thing along with amplitude and frequency modulation that is often mimicked in long binaural programs where people will often add the odd bird sound or temple bell to keep you awake while generating waves like Delta waves that tend to put you to sleep.

In the end, you would actually be better off just going to the beach for a day or going hiking into the forest. To add to the music of earth you could take a didgeridoo, flute or even just your own voice, nature and human instinct is in reality just as powerful as any techniques mentioned in this book.

However, I must say that having a computer with all its unit converters, having synthesizers that can play pure sine waves or be tuned to exact Hz frequencies and having internet and access to so much information is quite something. These are the things that Pythagoras and Ptolemy did not have. Without the technology to generate scales and charts I would never have understood the truth about nature, even though I already knew it. It proved to me that my childhood method of only using the white keys (and F# the black sheep) was in fact a very cosmic thing indeed, although to me at the time it just made sense and felt right.

Understanding vibration has definitely helped me to understand life too, for example, living in harmony with the people around me has a similar effect on my life to the effect that it has on my music. It creates better connections, more options, more friends and fewer enemies. Now that I know everything is connected just like a fractal, living a good healthy life just makes more sense than it did before, while making harmonic based music just seems like the normal way to do things.

I have used the laws of sound to understand many things that people do but that are not good for them. For example turning a blind eye to evil things or pretending that things do not exist, from a sound perspective this is like the mystery of the dripping tap. If you have a dripping tap in your house and you just ignore it without getting up to fix it, your brain will eventually edit out that sound so you do not hear it anymore. The problem with that is that it will also filter out any other sound in the same frequency range narrowing your field of perception. To me this means that turning a blind eye to a fact will blind you to other facts in the same range of reality, making you blind to other things too. It makes sense, how can a blind eye expect to see?

After looking at the vibrational frequencies of our chakras and our brainwaves we can also see another trend. With chakras, the lowest vibrations are always connected to primal things such as survival, sex, food, competition, selfishness, general stupidity, war and material gains, similar to brainwaves where they are connected to sleep, unconsciousness, no dreams etc.

The highest vibrations on the other hand (with Chakras) are connected to enlightenment, higher intelligence, peace, kindness, sharing, selflessness, meditating in nature and such nice things. With brainwaves they are connected to similar feelings of unity, spiritual insight and problem solving.

Everything seems to work like this. Music with mostly bass will be more primal, while classical harmonic music with higher frequencies and less heavy bass or even nature sounds like frogs and bird songs will be more intellectual and enlightening.

Even food works like this. Light food that is full of nature like strawberries can raise your vibration and make you happy, while heavy dead food like meat or artificial food full of chemicals can lower it and make you tired. Our feelings are the same, if you are happy, full of love and peace living out in nature, you will have much a higher vibration than when you are sad or depressed or sitting in an office making some other fools rich.

You can do your own experiments with your personal vibration. For example, next time you go to the shop buy a nice big sandwich to give to the first homeless person that you see. Now take note of how your body and mind feels afterwards, do you feel weak or strong? Does your mind feel clear? Obviously it does, this is because you have just raised your own vibration. If you like the feeling and want it to last longer then don't advertise what you did, keep it secret and then see how nice you feel! This is the vibration you need to be in to make the best music and art and to be happy and healthy.

Now if you compare this feeling to the feeling that you have after an argument or another situation with dis-harmonic vibrations you will understand easily. After an argument you don't feel strong at all, you always feel weak and stupid even if you "won" the fight. There is no way you can make good music after a fight because your body is just filled with adrenalin and stress, which puts you in a fight or flight state with limited brain function and an increased primal urges. This is what you call a low vibrational state, and it is dangerous because if you go too low in your vibration your intelligence decreases at the same time making you a danger to others and to yourself.

Generally higher vibrations are where we want to be. If we can raise our vibration then it seems all the good things in life will come to us, love, health, wisdom, happiness, energy, vitality, clearer thoughts and higher intelligence.

Re-incarnation

Many people believe that the choices you make while on earth have an effect on your existence beyond this life. One day you will die and then your soul will move on to a new place. As everything works with levels of vibration and entrainment, there must be realities with a higher vibration than this one, in the next "octave" of reality so to speak. Some people know this as heaven, a world where everything is lighter, brighter and full of peace and love.

It is highly unlikely that you would only live one life and then either go to one place called "heaven" or go to a another place called "hell" permanently like some people believe. I think this is more of a constant journey in which when you die you go to a place with a vibration that matches your current level. In this way everybody is happy, and nobody gets "punished".

A greedy, selfish person who loves power and material gain will have a fairly low vibration most of the time. When they die they may end up back in this world or a similar one because this is really what they want: more stuff. But no matter how much they have they will never be happy, because there is always a “stuff ver 2.4”.

If however you are a person who spends their life exploring the realms of love, consciousness, kindness and sharing, then you may raise your vibration to a level where it is no longer matched with this realm. Your vibration may then become more suited to a higher vibrational version of reality, one where everybody is kind and caring and filled with love, in which case your next life may be spent in such a place.

I am sure things are much more complex than this with delayed karma, “fallen angels” and such things that could cause a person to ascend and then descend again later.

The obvious problem with getting re-incarnated over and over again on earth or another earth-like planet is that nobody here seems to be able to remember their past lives very clearly, almost like a total memory wipe. Greedy or nasty people who take their lives too seriously might be making a mistake because they may keep coming back forever complete with a new memory wipe each time. Each life would be quite irrelevant since it gets forgotten over and over again, after too many such lives your spirit may become entrained to this low frequency and may forget about the higher realms entirely. Once you get too deep into this reality it may take an immeasurable amount of time to find your way out again, like a blind deaf mouse with no nose looking for some food.

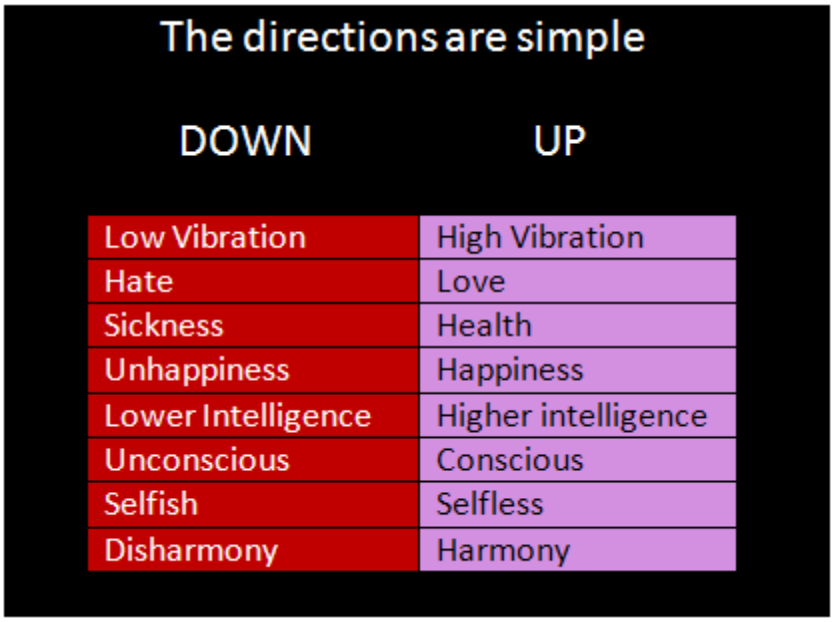
On the other hand I have heard (but have no proof) that if you manage to raise your vibration enough to break free from this realm, that you will then be able to remember all of your past lives. So it may just be worth it to not be greedy while you are alive.

Before organized religion became an institution for manipulation, the general idea was to follow a similar principle of living your life at the highest possible vibration. Eating the right foods and doing the right things was how you ensured your entry into "heaven", the higher vibrational realm.

These ideas are very similar to those of Pythagoras and those ancient mystery schools. Using the color spectrum and harmonics as a base for 7 frequencies with ascending vibration to match human states of body and mind also is not a new idea, “they” have been doing this thousands of years ago already.

It is obvious that greed and nasty actions are a waste of time because as long as there are unhappy, angry or hungry people on the earth, they will change the reality via the laws of entrainment making it less pleasant for all. Imagine a world where the major priority is to ensure everybody's happiness, then we would be able to go anywhere on this earth without fear of robbery or attack because nobody would be unhappy or jealous. In such a world even the billionaires of today would have more options than they do now, more places they could go and more things that they could do. Creating a world of separation is limiting the reality of those who seek to control too, now they have to hide on small private islands and can never go to all the other fun places, mingle with crowds or meet some of the most non-materialistic and spiritual people.

I will end this book with one last chart, a navigational chart of sorts:



For more info or help with scales contact me or join my Facebook Group, just search for the name "Life, the Universe and 432 Hz"

Or use this ink: https://www.facebook.com/groups/345636055517218/

Website: http://mathemagicalmusic.weebly.com/

Ambient music: https://indigoaura.bandcamp.com/

Binaural trance music: http://psychederic.bandcamp.com/

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